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The Portrush Electric Railway.

In remarking upon the successful opening of the above road, the *London Electrician* says: We announced the opening of the Giant's Causeway, Portrush, and Bush Valley Electric Railway, which has been carried out by Mr. W. A. Traill, with the assistance of Mr. E. B. Price, and under the direction of Sir William Siemens. We are now able to give a description of the machinery adopted for utilizing the water power of the River Bush to drive the dynamo machines used to generate the necessary current.

At a picturesque spot, known as the Salmon Leap, about three-quarters of a mile from the present terminus of the Giant's Causeway Electrical Railway, the river Bush has a fall of 26 ft., a natural advantage as a source of motive power not lost sight of by the promoters of the railway, who have now utilized it for working their dynamo machines. Two turbines, each capable of yielding 50 horse-power at 225 revolutions per minute, are placed in a recess dug out of the solid rock on one bank of the river, and are secured to girders built in concrete and masonry (*vide* Figs. 1 and 2). The water is conducted from its highest point through conduits of considerable length into a wood tank 9 feet wide which bridges the recess, and in which are two sluice valves for opening or closing the inlets to two wrought-iron tubes, each 3 ft. 6 in. diameter, connecting the tank with the turbines. A framework of wrought-iron joists is placed on the top of the tank, fitted with standards and pedestals for shafting, and is supported at one end by two columns carried down to a girder spanning the walls underneath, whilst the other end is built into a wall. The governors are mounted on a frame and are driven by spur wheels from the upright shafts. An eccentric—not shown on drawing—on the governor spindle works a lever and ratchets on opposite sides of a small wheel, to give motion in opposite directions, according as one ratchet or the other is thrown into gear, to a screw on which a nut can travel a sufficient length to move the turbine gate spindle through a quadrant of a circle—the travel of the regulating vanes. A slip motion is attached to the screw at each end to prevent motion beyond fixed limits. When the turbines are running at the proper speed both ratchets are thrown out of gear by the governor, and when fast or slow the opening or closing ratchet is slipped into gear by a cam until the inlet opening of turbine is adjusted to correspond.

Two chains are carried from the machine house to the regulating gear, so that the gates of the turbine may be opened or closed by hand. On the top of the upright shafts are two pairs of bevel wheels to drive two horizontal shafts, on each of which is fitted Addyman's friction coupling, whereby both turbines may be left to run idle, or either or both may be put into gear.

A spur wheel on the inner end of each shaft gears into a wheel on another shaft placed immediately above and carried into the machine house, the centers of which wheels would be represented by the three points of a triangle. Thus the turbines may be used singly or together. On the dynamo main driving shaft, again, is placed a friction pulley, which runs or stands according as a wedge is inserted or withdrawn, and the dynamo machine itself may be stopped or started whilst the shaft is in motion, without moving the belt. All the operating levers are brought to one point, and are fixed to a beam in the machine house, duly labelled to show at a glance their different purposes. Only one dynamo machine is worked at present, but it is intended to lengthen the main shaft in the machine house and work two, preparations for which are already made. The available power—100 h. p.—is ample for all the requirements of the line, and now that it is in operation will very greatly reduce the working expenses. The whole of the shafting and gearing has been executed by Messrs. J. Bagshaw & Sons, engineers, Batley, under instructions from Mr. W. A. Traill, chief engineer of the tramway company.

The tramcars are fitted with Price's automatic brake. The brake has been fitted to

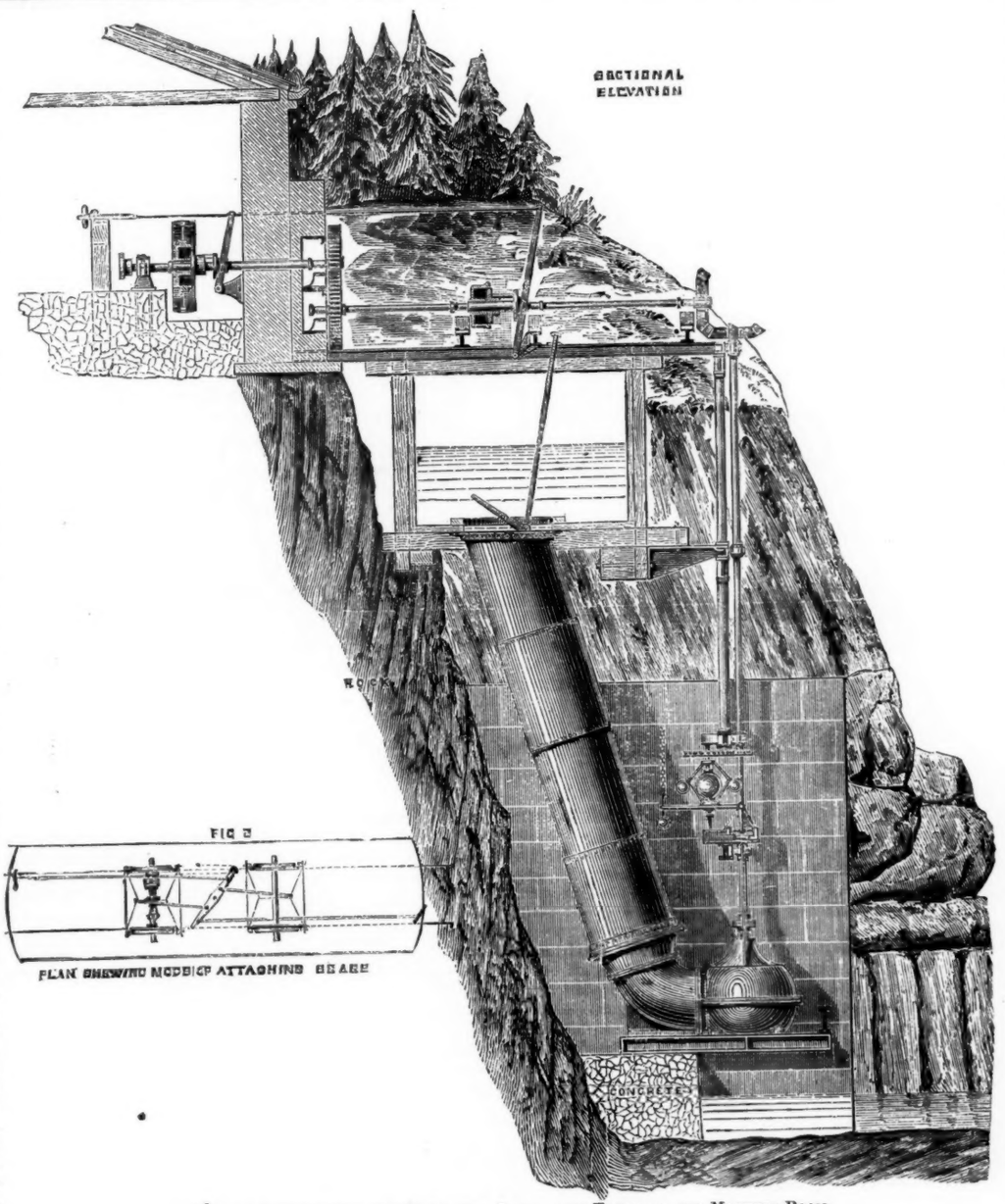


FIG. 1.—ILLUSTRATION OF THE SALMON LEAP, WITH TURBINES AND MACHINE ROOM.

all the electric cars to meet the requirements of the Board of Trade, and Major-General Hutchinson, at a recent inspection, after trying the car down steep inclines with full power turned on, expressed himself satisfied with its performance, and reported that "an efficient brake had been supplied."

International Electrical Exhibition in Philadelphia.

TO OPEN TUESDAY, SEPT. 2D, 1884.

The attention of all persons interested in the generation and application of electricity is respectfully invited to the exhibition of electricity and electrical appliances to be held in Philadelphia, United States of America, commencing on Tuesday, September 2d, 1884, under the auspices of the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts.

From the eminent reputation of this institution, coupled with the fact that the projected exhibition will be the first in America exclusively devoted to this important and progressing branch of science, the above announcement has attracted unusual interest throughout the United States, and the exhibition will undoubtedly afford an admirable opportunity of witnessing a representative display of American discovery and invention in electricity.

To increase its scientific and industrial importance, as well as to add to its attractiveness, it was determined shortly after its inception to give it an international character. The importance of the project having been properly represented to the Congress of the United States, an act was passed which, having received the signature of the President of the United States, is now the law.

This official recognition provides for the admission into the United States, duty free, of all articles for exhibition only. The text of this act of Congress is as follows:

"*Whereas*, The Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts proposes to hold an exhibition of electrical apparatus, machinery, tools and implements, and other articles used in scientific and mechanical and manufacturing business and investigations; and

"*Whereas*, It is deemed desirable to promote the success of such an exhibition by all reasonable encouragement, in order that it may be made useful for the promotion of knowledge; therefore, be it

"*Resolved*, By the Senate and House of Representatives of the United States of America, in Congress assembled, that all articles that shall be imported for the sole purpose of exhibition at the exhibition to be held by the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, in the city of Philadelphia, in the years 1883 or 1884, shall be admitted without payment of duty or customs fees or charges, under such regulations as the Secretary of the Treasury shall prescribe; *provided*, that all such articles as shall be sold in the United States, or withdrawn for consumption therein at any time after such importation, shall be subject to the duties, if any, imposed on like articles by the revenue laws in force at the date of importation; *and provided, further*, that in case any article imported under the provisions of this joint resolution shall be withdrawn for consumption, or shall be sold without payment of duty as required by law, all the penalties prescribed by the revenue laws shall be applied and enforced against such articles, and against the persons who may be guilty of such withdrawal or sales."

It remains only to add, at the present time, that no effort will be spared by the Franklin Institute to secure a large and important representation of the progress of foreign countries, and that the most liberal provisions will be made to place European and American exhibitors on a fair and equal footing.

The subject of electricity and its applications is at present attracting an unusual amount of attention, and the exhibition side by side of the best achievements of Europe and America cannot fail to be in the highest degree instructive.

All information required by exhibitors, including the classification of exhibits, regulations for the entry of articles for competition, advices as to the best modes of transportation, custom-house regulations, and all other needful information, will be furnished to parties making application for space for exhibition.

Such applications should be made to the Secretary, Franklin Institute, Philadelphia, U. S. A.

The New Bedford Electric Lighting Company, New Bedford, Mass., was started up two months ago, and is proving to be a great success. They use the Thomson-Houston Company system of dynamos and lamps. This station is a model of its kind, and they have now in use two dynamo-electric machines; these are run by an Armington & Sims Company 9½"x12" engine, and steam is furnished by a tubular boiler, set with the Jarvis furnace. The fuel is screenings and pea coal, burnt on the Sheffield grate bars. All the lights are sold, and, orders having been received for more, they have decided to increase their plant and have ordered another dynamo; also more Armington & Sims Company engines.

Fuel to produce electricity is thus described by Dr. Beard: The electric current is formed by the combustion of coal at a high temperature and in the presence of potassium or sodium nitrate. The fuel is shaped into bricks of convenient size and covered on the outside with asbestos paper. The interior of the bricks consist of a coal and saltpetre prism separated by a thin sheet of asbestos. The bricks contain a large number of holes, which serve to facilitate the combustion and increase the number of points in contact with the saltpetre. A copper wire is introduced into the coal and saltpetre prisms, the ends of which form the poles of the element. One brick is capable of working an electric bell.

A Watch Which Goes by Electricity.

A Jewish young man, 19 years old, named Solomon Schisgal, has invented a watch which goes by electricity, and with scarcely any movement; it is therefore simple in construction and easy to handle. Herr Chwolson, professor of physics at the University of St. Petersburg, has written an article on the subject in the Nowosti, in which he says: "In its remarkable simplicity this invention can only be compared with the Jablochkoff system of electric lighting. The watches are without any springs, and consist solely of two wheels. Besides being true, they have the advantage of the second hand moving in single momentary leaps, as is usually the case only in very costly watches, and which is of the utmost utility for astronomical observations. These watches can also set in motion a certain number of watches of the same construction, so that they all keep exact time. The invention has convinced me that watches can be used for the purposes of telegraphy." After naming several other advantages, Professor Chwolson describes the invention as a wonder which will cause an entire revolution in the manufacture of watches. Herr Schisgal is the son of a Jewish watchmaker in Berditschew, Russia.

Some progress has been made in Vienna with the electric railway, and great energy is said to characterize the management. Already have the working plans of the first section been lodged with the Government, and they are now receiving the examination prescribed by law as a necessary step before further work is begun. Meanwhile similar plans for the remaining sections of the railway are being proceeded with.

Among the novelties at the electrical exhibition at Nice will be a diving-bell lighted by electricity and connected with the surface by a telephone.

Electric Motor for Balloons.

M. G. Tissandier has described to the Paris Academy of Science his new electric motor for balloons. It consists of a screw propeller with two helicoidal blades nearly ten feet in diameter; a Siemens dynamo-electrical machine of new design, and a light bichromate of potash battery. It is intended to propel an elongated balloon of about 1,000 cubic yards capacity. The frame of the screw propeller weighs fifteen and a half pounds, is stretched of silk varnished with India rubber lacquer, and kept taut by steel wire stretchers. The dynamo-electric machine has four electro-magnets in the circuit, and the frame parts are of cast steel, so as to bring the weight down to 121 pounds. It drives the screw by gear, which reduces the speed in the proportion of 10 to 1. Thus, if the coil makes 1,200 revolutions per minute, the screw makes 120. It gives out 220 foot-pounds per second with a useful effect of 55 per cent. The bichromate battery gives a better yield than accumulators of the same weight. It consists of an element divided into four series and arranged in tension. The element consists of an ebonite cell holding four liters (or 0.88 of a gallon) and containing ten plates of zinc and eleven cakes of retort carbon, arranged alternately. The immersed surface of the zinc is one-third that of the carbons. This battery, charged with a highly concentrated and very acid solution, is constant for two hours. The liquid becomes heated as it is impoverished, and the duration of activity may be prolonged by the addition of chromic acid.—*Eng*

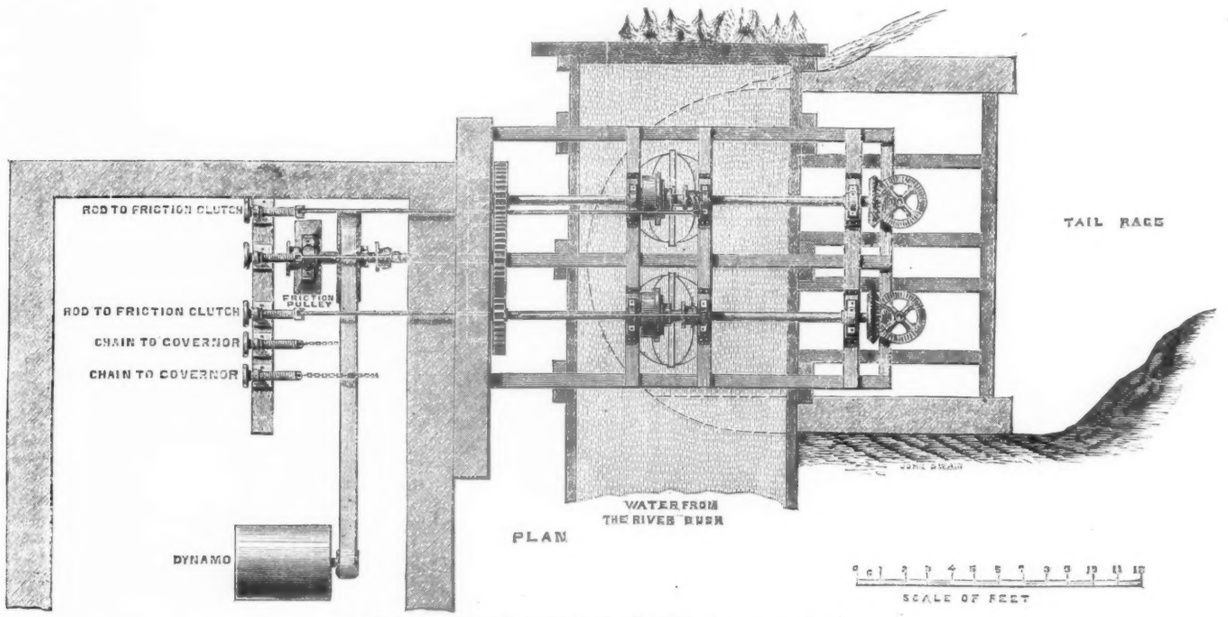


FIG. 2.—PLAN OF MACHINE ROOM, TURBINE ARRANGEMENTS, &C.

The Varley accumulator or storage battery is described as composed of elements made of cotton or other woven fibrous material, carbonized and placed in cells charged with a saturated solution of two parts of sulphate of zinc, and one part of sulphate of manganese, with a small quantity of sulphate of mercury to prevent local action on the deposited zinc. In charging the storage battery metallic zinc is deposited on one carbon pole and bioxide of manganese in electrical continuity on the other; the latter pole in use absorbing the hydrogen, the former oxygen. The advantage claimed for this battery over the lead accumulator is chiefly its less bulk and weight, with great storage capacity.

The Commissioner of Patents, reversing a recent decision in his office, has awarded priority of invention of the incandescent conductor for an electric lamp, formed by carbonized paper, to Sawyer & Mann, against Edison.

Cooking by Electricity.

Some parties in Canada have invented a machine for cooking by electricity. It consists of a saucepan, or hot plate, so isolated by non-conductors that the bottom forms the positive pole of a current. The other pole is attached to a movable point, which travels over the under surface of the pan in circles sufficiently quick not to burn a hole through. Some cakes were cooked in the apparatus and eaten by the inventor and his family, who are believed to be the first members of the human race who have eaten food cooked by the electric spark. One lady declared she tasted the flavor of electricity "quite strong."

Electrical lighting is to speedily become an established fact in Lewiston and Auburn, Me. A long and stormy session of the Lewiston city government on Thursday evening granted the petitioners of the Consolidated Electric Lighting Company of Maine, using the Thomson-Houston system, for right to establish a plant and poles lines, in the face of a strong opposition from a rival company, and similar action has been taken by the Auburn board. Work will begin at once. A local board of directors has been chosen, consisting of the Hon. E. F. Packer, president of First National Bank; C. J. Barker, manager of the Bates mills; F. W. Parker, treasurer of Androscoggin Savings Bank; Asa Cushman, G. C. Wing, R. C. Reynolds and H. N. Wagg.

Providence, R. I.

Captain R. C. Brown, superintendent of the Rhode Island Electric Lighting Company, reports an excellent fall business, a large portion of it in the mills in that locality. The company are now putting in a 400-light plant of incandescent lamps into one large mill, and will soon be at work on another plant of 200 lights for the purpose.

Mr. Louis W. Clarke has removed his offices and factory from the Butter Exchange Buildings into more commodious and better-located quarters at 134 Westminster Street. Mr. Clarke does a general electrical, gas-lighting, alarm and annunciator business.

The World's Money.

The director of the mint, in his annual report, reiterates his estimate that the amount of gold and gold bullion available for immediate coinage in the United States is about $606,000,000—a statement which has been greatly criticised by experts—and makes additional estimates as to the world's money, which, possibly, may not meet with less severe criticism. The mint bureau certainly should have the best means for accurate information on the subject. Nearly all of the gold and silver obtained from our mines is in some form deposited in the mints and assay offices, or exported through the custom houses. Records are kept of the character of every deposit, and of the locality of the production of domestic bullion. The gold product for the calendar year 1882 declined $2,200,000, while the silver product increased $3,800,000. The deposits of gold bullion for the first eight months of 1883 show also a decrease as compared with the corresponding period of last year, while the silver deposits show an increase. The estimate for the present calendar year is that the production of gold will be at least $500,000 less, and that of silver at least $2,000,000 greater, than that of the previous year.

Director Burchard's estimate of the coin in circulation in the United States is $846,595,749, of which $606,196,515 is gold, and $240,399,234 silver. The director bases this estimate on the statistics of the mint and assay offices as to the amount taken from the mines, on the reports of the Treasurer of the United States as to the amount in the Treasury, and on the Custom House returns of the amounts exported. To all adverse criticisms upon these statements, he simply answers "the amount is there." The director's returns, so far as they are based on actual figures of the government, and not upon estimates, can probably not be successfully combated. His statement as to the total United States circulation is subject unquestionably, to greater exception, for it is based, to some extent, upon estimates. His conclusion is, that on October 1, 1883, the total United States money in circulation was $1,070,364,021, as against $1,051,248,386 on October 1, 1882, or a net increase during that calendar year of $19,115,635. Mr. Burchard takes no account in this estimate of the unredeemed legal tender, demand and interest-bearing notes, which he considers as out of circulation. He does include the gold and silver bullion in the Treasury, and he states that it may properly be counted as a part of the metallic reserve, for the reason that it is capable of conversion into coin. The statement as to the paper currency is based upon the returns of the national banks of June 22. Since that date several calls of 3 per cent. bonds have been made, with the result, as the Comptroller of the Currency estimates, of an aggregate retirement of national bank circulation of some $12,000,000. This sum should properly be deducted from the estimate of Director Burchard as to the amount of money in active circulation, which would reduce his net gain of the calendar year to $7,000,000.

The returns as to the coinage of foreign countries contain some interesting facts. In Great Britain no gold was coined in 1882. The best estimate of the gold coin in circulation in the United Kingdom is 110,000,000 pounds sterling, and of paper money 43,721,000 pounds sterling. The gold coinage of France in 1882 amounted to 3,742,000 francs, and the silver coinage to 7,159,859 francs. Mr. Burchard puts the total paper circulation of the thirty-eight principal countries at $3,832,920,903; the gold circulation at $3,333,433,000, and the silver coin at $2,712,226,000.

The Southern Electric Light Company.

The certificate of the incorporation of this company, whose main purpose is to supply cities and towns in the Southern States with electric lights, was filed in the County Clerk's office, this city, Nov. 15. The capital stock of the new company is $500,000, divided in 5,000 shares of $100 each. Its corporators are William J. Cahoone, Oscar King, and Henry C. Elliott, of this city, who, with John C. Calhoun, of Arkansas; James Lingan, of Louisiana; Patrick Calhoun, of Georgia; J. P. Hodgeson, of Texas, and Edward C. Hancock and James H. Shorter, of this State, form its board of trustees for the first year.

Probably the strongest single electric light in this country is suspended in front of the *Record* building in Philadelphia, about 90 feet above the level of the street. It is equal to 10,000 candles.

An international Society of Electricians has been formed in Paris under the Presidency of the Minister of Posts and Telegraphs, its main object being to centralize all information bearing on the progress of electricity, and to promote its spread and development. Information as to the society may be obtained by writing to M. Georges Berger, 99 Rue de Grenelle, Paris.

Magnets.

It is well known to electricians that the best steel makes the best permanent magnet. But the magnetism of steel depends on how hot or how cold the metal is. For example, steel loses its magnetism if subjected to a temperature of 100° below zero; it also loses its magnetism when heated to a yellow heat; that is, between red and white heats. Soft iron, when heated red not, is not attracted by a magnet.

In the manufacture of telephone and magneto instruments, there is probably nothing of more importance than the magnet; and therefore the material from which the best magnets can be made is of the greatest interest to the scientific world.

After making some inquiries, we find that the article known as the chrome cast steel is and has been giving the best satisfaction in the manufacture of permanent magnets.

In a recent visit to the Chrome Steel Works, Brooklyn, E. D., N. Y., we saw the steel in different stages of manufacture, also unmistakable evidences of the uniformity of the material, which is most necessary.

Chrome cast steel has been and is now being used extensively in the manufacture of magnets by some of the largest and most successful manufacturers of electro-magnetic machinery for several years past, and they testify as to its superiority.

We also had special tests made by the largest electric company in the country, of permanent magnets made from chrome cast steel, with the extraordinary result of a test through a resistance of thirty-five hundred (3,500) ohms, which is remarkable, as a magnet holding against a resistance of fifteen hundred (1,500) ohms has heretofore been considered a first-class magnet.

From what we have seen, we do not hesitate to say that there is no doubt that in the near future all permanent magnets will be made from chrome cast steel, unless some material which will prove superior should be developed.

The falls of the Rhine have been illuminated with the electric light by the hotel keepers at Schaffhausen and Neuhausen recently to increase the attraction for visitors.

M. P. Tihou has shown a new incandescent lamp to the Industrial Society of Lyons, France. A chalk rod is interposed between the carbon points of an arc lamp, and serves to maintain the arc, while it is itself heated to incandescence, giving off an increased light, which does not vary as quickly as the current which feeds the lamps, and thus serves to keep the illumination steady.

The Swiss railroad companies now cover a portion of their carriages with a phosphorescent preparation, which makes them visible at night.

The Swedish and Danish governments have decided to lay a new sub-marine cable, of four wires, between Helsingborg and Elsinore, *via* the island of Hoeen.

The following may Interest our Readers

THE NEW ENGLAND WESTON ELECTRIC LIGHT COMPANY,
18 Post Office Square.
BOSTON, MASS., NOV. 6, 1883.

DEAR SIR—Certain statements injurious to the Weston-Maxim system of incandescent lighting have been widely circulated by agents and others representing the Edison system. Of those which have been seen by us in print or writing, not one is free from implied misstatements, and nearly all contain positive falsehoods, which could in most cases have been easily discovered to be such, had the desire to make a fair and reliable description existed.

We ask your attention to the following false statement recently brought to our notice, with its refutation, as illustrating the business methods of the parties referred to, believing that when its nature is once shown, such a course speaks for itself, and is its own best contradiction.

Extract from a paper circulated among the agents of the Edison Company and by them shown to inquirers and intending purchasers, as of date July 16:

"*Rhode Island.* * * * Grant Brothers, Olneyville, R. I., bought a Maxim plant because we would not contract to install our plant within a given period, which did not give us sufficient time to do it properly. The Maxim people agreed to do it, and to start on the day named, January 1st. The order was given to the Maxim people; the first day of February came and the mill was not wired, but we believe the mill has since been lighted. The manager stated that he knew the Edison Company had many skilled, scientific, and practical men in their employ, but he did not meet one in the Maxim Company. He has two machines, but they are not paid for, and will not be until a test is made, which, if the test is properly made, will prove fatal to the Maxim guarantee." * * *

OFFICE OF GRANT BROTHERS,
Olneyville, R. I., Oct. 20, 1883.

ANDREW ROBESON, ESQ., Treas.,
New England Weston Electric Light Co.,
Boston, Mass.

DEAR SIR—We are in receipt of your favor of the 19th inst., calling our attention to the contents of a paper said to be circulated among the agents of the Edison Company and to customers and inquirers generally.

As the statements quoted are liable to give an impression exactly the reverse of the truth, we will briefly give you the facts as they actually happened.

Our reason for giving your machine the preference was *not* because we could not get an Edison machine at the required date, January 1st, 1883. On the contrary, we have a letter from the Edison Company's agent, dated November 8th, 1882, offering, on receipt of an order within a week, to install the machine by January 1st, as desired. We had, however, unknown to either company, compared the operation of the Maxim and the Edison lights in the Boston Exhibition of last year, and afterwards in the plants operated in Rhode Island. We chose the Maxim solely because from observation and report we concluded that it was the best machine in the market, as regarded life of lamps, quality of light, and the regulating capacity and general durability of the machine.

Our subsequent experience has confirmed our first judgment, as you will discover upon reading the report of our six months' operation of your machines, shortly to be made to the R. I. Company.

In regard to the alleged delay on your company's part, in furnishing the machines, we will state that your dynamo was in our works several weeks before we were ready with the shafting, and the wires were promptly strung in advance of our needs.

The two machines were fully started April 3d and 30th respectively. We felt sufficiently well satisfied to make a payment on account, April 14th, and both machines were fully paid for in July, without any discount or rebate. The result of our test during about 1,500 hours, since April, instead of proving "fatal to the Maxim guarantee," has been far in advance of the guarantee, and very satisfactory to us. In short, we regard the Weston-Maxim system of incandescent lighting as the best of which we have any knowledge.

We remain, respectfully yours,
GRANT BROTHERS.

The lamp used by Messrs. Grant is an old-style, giving a trifle more light, but requiring nearly double the power of that we are now putting in. The prices given are in excess of our present rates.

This company, representing in New England the system of incandescent lighting, in regard to which such misstatements have been made, respectfully suggests that you receive with caution any statements concerning the same which may be made by its opponents.

Any information desired as to our systems of lighting, both arc and incandescent, will be gladly furnished on application.

Yours, respectfully,
THE N. E. WESTON ELECTRIC LIGHT CO.,
By ANDREW ROBESON, Treas.

The electric railway at Brighton, England, has proved so much of a success that it is proposed to extend it about two miles. The present railway is only about a quarter of a mile in length, and rests on the shingle, with ordinary flange rails, longitudinal sleepers being used. The prime mover is a gas engine, indicating three and a half horse-power, which drives a Siemens dynamo, the current from which is conveyed by the rails to the motor on the car. The latter is seated for twelve persons, but has carried sixteen, at an average speed of seven miles per hour, the gradient being 1 in 100. The daily run is from twenty-five to thirty miles, and the average daily number of passengers 350.

Secondary Batteries, and an Economical Method of Generating Steam for Electrical and Other Purposes.

BY C. H. W. BIGGS, F. C. S., AND W. W. BEAUMONT, C. E.

[Paper read before the British Association, Southport Meeting, September, 1883.]

Sir W. Siemens, in his remarks upon a previous paper, mentioned that information was needed as to the life of secondary batteries, and referred to results he had obtained. This paper deals with the results of experiments which have been carried out at the School of Electrical Engineering, principally under the direction of Messrs. Desmond G. FitzGerald and T. J. Jones, by their assistants Messrs. Schiassi and Dornbusch.

It is not our intention to enter minutely into the theory of storage batteries, but rather to rapidly glance at the practical difficulties which have been met with in the attempts to develop the use of this apparatus. The popular mind holds to the idea that storage batteries have long been perfect, and wonders why they have not been far more extensively used. We hold that one of the first steps towards success is to know the causes of failure. Having found a cause we can then try to find a remedy. Some of the causes which operated against the immediate and extensive use of storage batteries are known, and various remedies have been and are being tried. A very brief reference to the principal batteries in use will enable us better to describe their faults. Without going back to older experiments, let us take the Planté form as a starting point. This consisted of lead plates opposed to each other forming the positive and negative plates of the cell, and rendered excessively porous by a long continued succession of charging and discharging, the charging current being at first often reversed. After charging, one plate was found to be covered to a greater or less depth with peroxide of lead, the other being pure lead or perhaps hydrogenised lead. Upon connecting the peroxidised plate by an external circuit with the opposite plate, the peroxide was reduced and the reduction accompanied by the phenomenon of a current of electricity. In order to obviate the time and energy lost in rendering the plates porous, M. Faure adopted the plan of coating lead plates with minium. This was found to give very favorable results, and the theory of this form of battery has been treated by Sir W. Thomson and Dr. Gladstone at previous meetings of the British Association. When, however, attempts were made to use this battery upon a practical scale certain faults were discovered, which led to modifications in the construction.

The most recent type is that known as the Sellon-Volckmar-Faure battery. In this a plate of lead is cast somewhat in the shape of a gridiron. The holes in the plate are filled with minium flush to the surface. The plate has then to be formed, a comparatively simple and inexpensive process when compared with the Planté formation. Still, so far as we know, these various modifications have not led far towards perfection. It is found (1), and this is perhaps the greatest difficulty to be overcome, that during the action of the charging current and after the action, if the plates remain in the electrolyte the plates bulge, or buckle, and this buckling frequently is so great as to cause the plates to touch. Then we have a "short circuit," and those plates or cells containing the short circuit are not only useless but are to be avoided at all hazards.

Besides the buckling tendency we have to guard against the loosening of the plugs of minium. Under the action of the current the formation of peroxide goes on, and expansion takes place. Upon the reduction of the peroxide there is the contraction. Now, even if the containing lead-plate or grid was not acted upon we should get a gradual loosening of the plugs, but the lead itself is acted upon, and the bad effect is hastened. The result is that the plugs drop out, or if they do not drop out, are loose, and the conductive continuity of the plate as a whole is weakened. One great aim in the construction of accumulators is to have the internal resistance as small as possible, therefore anything that increases this resistance is to be avoided.

The electro-chemical effects which have hitherto prevented the extended use of secondary batteries in electric lighting may be classified under two headings, viz :

1. Those relating to the cathode or reducing pole in charging ; and

2. Those relating to the anode or oxidising pole in charging.

The shortcomings to be referred to in the former category are, perhaps, more seriously detrimental than any other, since they interfere *ab initio* with the due working of the cells, whereas the other shortcomings lead merely to a certain loss of the electrical energy accumulated, and, to the ultimate destruction of the anode pole within a period of time which is inconveniently limited. It will be recognised and admitted by all who have had practical experience in the construction and working of secondary batteries that the initial difficulties in obtaining a really efficient reducing pole have been far greater than those in connection with an oxidising pole initially efficient and gradually augmenting in efficiency until the final breakdown of the elements by the disintegration of the entire mass.

CATHODE (CHARGING).

The difficulties in connection with the cathode element would appear in the usual forms of these batteries to have been almost entirely due to the use of a plate of lead in establishing contact with the active material, viz., sulphate of lead to be reduced in the operation of charging. In the first place sulphate of lead is reduced only with great difficulty and slowness by means of a lead cathode, especially when the electrolyte contains no constituent capable of holding in solution a portion of lead sulphate. Moreover, with an electrolyte of dilute sulphuric acid, lead and hydrogen are in such close proximity in the electro-chemical scale that a tendency exists to the electrolysis of the hydrogen compound (H_2SO_4) rather than to the electrolysis and reduction of the lead compound (sulphate of lead). The same tendency to the evolution of hydrogen which in the case of lead supports frequently results in an almost entire separation between the surface of these supports and the "active material," which should properly be in close contact with such surfaces, is no longer observed when a material, such as "carbon," strongly electro-negative to lead and hydrogen is employed in obtaining contact with the active material, nor have we very far to seek for the cause of this difference. It appears clearly to be traced to a "local action," which is active in the case of carbon.

If we suppose some portions of a carbon surface to be in close contact with lead sulphate, and other portions to be in direct contact with the fluid electrolyte, we may admit that the tendency to the evolution of hydrogen by the electrolysis of the hydrogen compound would be active mainly at the latter surfaces. Any hydrogen, however, separated by electrolysis would not be immediately evolved from the carbon surface, but would become "occluded" within the mass, rendering the surface in question powerfully electro-positive to carbon in its normal condition. Local currents would therefore be produced, due to the contact with each other and with an electrolyte, of two conductors which would be at a considerable distance from each other on the electro-chemical scale, and the effect of such local currents would be to bring about the recombination of the hydrogen liberated, and also a reduction of lead sulphate upon those portions of the carbon surface in close contact with the lead salt. In the case of the lead support no such local action could occur to any appreciable extent, by reason of the extreme weakness of the local currents which would be produced by the contact with each other, and with an electrolyte of lead "electroplated" with hydrogen and lead in its normal condition. In the plates with the ordinary lead support to the active material hydrogen is probably evolved as gas from the lead surface, and it will not be surprising that such evolution more or less completely breaks the connection between the support of metallic lead and the active material or layer of lead sulphate, which should be in the closest contact with it. Here, then, is another cause of weakness in a battery wherein the supporting material is lead, and we have every reason to believe that the use of carbon, as introduced by Messrs. Desmond, Fitz Gerald and Jones, will prove an effective remedy. At least, results of experiments carried out during the past two years, both on a small and a large scale, have been very satisfactory. But there are other reasons why lead supports are unsatisfactory; for instance, the surface of contact with the active material appears altogether insufficient when it is compared with the surface of contact obtained by saturating carbon fragments with lead sulphate, and (preferably) filling up the interstices with similar active material. The objection that the lead supporting plate is liable during the running down of the secondary couple to become more or less completely coated with a coherent film of lead sulphate, which film, in the subsequent operation of charging, becomes detached by the action of the hydrogen liberated (initially in very minute quantities) at the surface of the metal, is of course entirely inapplicable in the case of the carbon surface. If the considerations advanced are correct, the substitution of carbon for lead as the conductor or support for obtaining contact with the active material at the cathode or reducing pole is a very important improvement in the construction of secondary batteries. It must be mentioned that any similar use of carbon at the anode or oxidizing pole is not only detrimental, but absolutely destructive to the efficiency of the secondary couple based upon the electro-chemical reaction between metallic lead and the peroxide of the metal. It does not appear to be generally known, even amongst those who should know better, and therefore we hardly expect to be known by the thousand and one dabblers in applied electricity who appeal so continuously to the Patent Office, that it is impossible to produce a layer of lead peroxide in contact with carbon, and *a fortiori* in contact with any more oxidizable material such as copper. Thus, those who have from time to time suggested the use of carbon in secondary batteries have implicitly or explicitly assumed or intimated that this material is applicable equally to the cathode and to the anode. Experiments upon a large scale, giving results absolutely negative from a practical point of view, have completely demonstrated the fallacy of such an assumption.

A question will probably present itself to many minds, and may, perhaps, be at once answered. It might with some reason be supposed that a carbon surface, coated with reduced lead, would be electro-negative to a lead surface coated with the same material, and if this were the case the fact would certainly constitute a drawback to the use of carbon, for we cannot afford to sacrifice even a small percentage of the electromotive force which is ordinarily developed in secondary batteries of the Planté or Faure type. The result of a large number of experiments has, however, been to show that (until the couple is almost completely run down) the E.M.F. obtained from an element of lead reduced upon a surface of carbon, such element being opposed to a plate of lead with its surface peroxidized, is quite equal to that obtained with an element of lead reduced upon lead and similarly opposed by a surface of lead peroxide. Indeed, for some reason which we cannot as yet explain, the lead reduced upon carbon nearly invariably gives an E.M.F. very slightly higher than that obtained with the elements wholly composed of lead.

ANODE ELEMENT (CHARGING).

We have thus far dealt somewhat exhaustively with the cathode and the recent attempts to improve it. Giving the reasons which led to these attempts, and stating that the results have thus far proved satisfactory, we must now turn our attention to the anode in charging. The electro-chemical difficulties in connection with the anode may be referred to the fact that peroxide of lead, the [illegible] electro-negative of all conductors, forms a local couple with the lead support with which it is in contact, as well as with the electrolyte, it is in contact. The action of the local current, as is well understood, is to convert the metallic lead into lead sulphate, or lead oxide, and reduce the lead peroxide to a lower stage of oxidation. The detrimental effect of this action is twofold. The couple, when charged, tends to "run down" with considerable rapidity, by the production of local currents, at the expense of the peroxide of lead and the lead conductor in contact with it. Most secondary batteries, as at present constructed, cannot therefore be left at rest after charging without some appreciable loss in the quantity of lead peroxide—that is, in the quantity of electrical energy accumulated. Indeed, the local action goes on to some extent *pari passu* with the action producing the current in the external circuit. This local action results in a very limited period in the complete disintegration, and consequent destruction, of the element, no portion of which is left unaltered to maintain efficient contact with the mass of peroxide. This is the same as saying [illegible] the Planté plate when giving its best results is upon the verge of destruction when it is wholly porous, and when it is completely peroxidized then it is useless. A portion of lead must be left to act as the conductor or contact piece. The improvements then in the anode tend to allow it to retain its charge for days and weeks with but a small percentage of loss in the energy accumulated. The accumulation of energy should, unless drawn upon, be practically permanent, and this would lengthen the life of the plate, and avoid frequent inspections and renewals. There would appear to be only two possible means by which the local action in a charged up anode can be effectively decreased, and the life of the anode be considerably augmented. These means are (1) to oppose a resistance as great as possible to the passage of the local currents which tend to pass in the substance of the charged elements, and (2) to employ as the conductor in contact with the active material a substance decidedly electro-negative to ordinary lead, and therefore constituting a far less effective local couple with peroxide of lead than does metallic lead, whilst, at the same time, it is not subject to oxidation or disintegration.

Let us, then, consider briefly the use of impervious non-conducting materials in preventing local action in the element which is the anode in charging.

Let us suppose that we take as our anode plate (charging) a sheet of lead of any required size, and about $\frac{3}{32}$ in. or $\frac{1}{8}$ in. thick (rendered spongy wholly or in part by minute perforations), a form experimented with by the writers during the past two years. Minute perforations can be machine made. If used at once as an anode without preserving precautions, this element would rapidly improve up to a certain point, when it would rapidly deteriorate by reason of defective contact with the peroxidised material resulting from the almost complete conversion with peroxide of the metallic mass. Now let us suppose, as was first suggested by Mr. FitzGerald, that the surface of the lead is in part protected by a sheet of impervious non-conducting material perforated with apertures, and strongly adherent to the metallic surface.

A suitable material for this protective covering should be detrimentally acted upon neither chemically by the electrolyte nor electro-chemically by the effect of the current upon the latter. In the operation of charging, the exposed portions of the plate would immediately be attacked, and we may suppose the conversion taking place at these portions to have extended quite through the substance of the plate. The element would then be constituted by masses of lead peroxide supported in frames or in a lattice of metallic lead. Some amount of local action will undoubtedly take place between the lead peroxide formed and the metallic substance of the frames or lattice. In the local circuits the current passes from the unaltered metal to the electrolyte, and thence back to the metal through the peroxide. The electro-chemical effect will vary

...tly as the E. M. F. between the lead ... lead peroxide, and inversely as the re... nce to the passage of the local currents. ...will result in the conversion of the metal into lead sulphate or oxide, and in the reduc...n of a portion of the peroxide to a lower ...gree of oxidation. But it is easy to perceive that as this local action extends laterally in the direction of the plane of the plate, the resistance to the passage of the local currents will become enormously augmented, mainly by the diminution of the quantity of the electrolyte which is present in the path of these circuits; and when we consider that the depth to which the conversion produced by these currents must extend under these conditions of resistance in order to operate (the destruction of the metallic frames or lattice may be made very considerable, say from $\frac{1}{4}$ in. to $\frac{3}{4}$ in. of metal to be converted), it becomes easy to realise that the life of an element so constructed may be vastly extended. When, in fact, the destructive action has extended laterally to a depth of some $\frac{1}{16}$ in. along the interior surface of the protective covering, the ...tion seems to be almost arrested. A ...condary battery, constructed with such anodes, may, *when fully charged*, be left to rest days or even weeks without appreciable ...s. After such period of rest it is ex...dient, if not absolutely necessary, to pass a charging current through the battery during a few minutes in order to convert into peroxide the minute quantities of lead sulphate or oxide which may have been produced by local action. By adopting this precaution ...e resistance is increased, but the increase ...very small, and not at all comparable ...th what it would be if the same course ...s adopted with the cathode. It is well understood, in fact, that the surface of the ...ode in charging may be made somewhat less than that of the cathode without any appreciable detriment. The device of partly protecting the anode surface with a view to retain unaltered metal for support and contact with the active material, might, *prima facie*, be regarded as crude and unsatisfactory. Our view is that the method is in reality based upon safe scientific principles, and this view has been confirmed by the experimental results obtained. The choice of materials to be employed for protective purposes is very limited. One of the best ma...ials hitherto tried is that known as "Prout's glue."

With regard to the second device, the use ...conductors electro-negative to lead for ... support of the active material in the anode in charging, so that a comparative ineffective local couple is formed to cause loss, the choice of material is very limited. A metal, such as copper, silver, or antimony, which forms a soluble sulphate by the effect of the electrolytic action is, of course, inadmissible. Carbon is also quite out of the ...estion, not so much by reason of its rapid ...integration, but from the fact that lead ...roxide reacts upon this element, and cannot electrically be produced in contact with it. Gold and platinum cannot be employed, not alone by reason of their expense, but because it is impossible to assume that strips or flakes of very minute thickness would be permanent under the conditions of practice. An alloy has, however, been found decidedly electro-negative to lead, and has given very encouraging results; but although we may be unable to say more in this direction, we have given our reasons for looking in this direction, and it may be that some chemist or electrician now present may be able to suggest a material which will answer the requirements.—*London Electrician.*

On a Method of Producing Electro-Magnetic Disturbances of Comparatively Short Wave.*

By Professor Fitzgerald, F.R.S.

This is by utilising the alternating currents produced when an accumulator is discharged through a small resistance. It would be possible to produce waves of as little as 10 meters wave length, or even less.

* Paper read before the British Association Southport Meeting, Sept, 1883.

On Currents of Emersion.

By M. Krouchkoll.

Two electrodes of one and the same metal being immersed in a liquid, it is known that if one of them is set in motion within the liquid there is produced a current, the direction of which varies with the nature of the metal and of the liquid in contact. These phenomena have been studied in detail by M. E. Becquerel. We know, on the other hand, that if one of the electrodes is placed in the liquid and the other is plunged in also, there is produced a current at the moment of immersion. An electric effect of the same kind is obtained at the moment when one of the electrodes is withdrawn from the liquid; there is produced a slight emersion current, and I believe that there exists the following simple relation between these three kinds of currents: "The current produced by emersion is contrary in direction to that produced by movement; the emersion current is in the same direction as the movement current."

Thus, if we plunge a platinum wire, well depolarized into acidulated water, the wire becomes positively electrized at the moment of immersion; it becomes negative if it is moved in the liquid, and negative also if withdrawn from the liquid. The same platinum wire is electrified negatively when plunged into water holding in solution common salt ($\frac{1}{50}$); it becomes positive if moved in the liquid, and also at the moment when withdrawn from the liquid. The same effects are obtained with pure gold.

A silver wire, freshly amalgamated, gives in acidulated water the same results as silver and gold, in direction, but more intensely. In salt water amalgamated silver behaves the same as in acidulated water, contrary to what takes place with gold and platinum.

To perform these experiments we make use of two wires of platinum, gold or amalgated silver, which are welded into glass. The two wires plunge into two glasses communicating with each other by means of a syphon. The platinum and gold wires are well washed in nitric acid, and then heated to redness; silver wires are freshly amalgamated. The water, feebly acidulated or salted, is boiled previously. When operating with platinum, the acidulated water should be very strong. The two wires are placed in connection with a Lippmann's electrometer. This instrument alone can be employed in experiments of this kind; we thus avoid the polarization of one of these wires by the other, and its extreme sensibility renders it possible to observe all the successive electric states through which the wire passes from the moment when it is placed in contact with the liquid to when it is drawn out. The bare part of the wire is bent at a right angle with the tube in which it is soldered, so that all its surface may be plunged into the liquid at once and withdrawn in the same manner. There is placed in the circuit a derivation taken from a Daniell, so as to compensate the electric differences which almost always exist between two wires of the same metal, and to insure at the outset the most perfect electric equilibrium possible.

We may in these experiments replace the air with an insulating liquid, *e. g.*, benzine, and instead of passing from air into salt or acidified water pass into them from benzine. The same effects are obtained.

In the course of these experiments I have remarked that ether, left for some time in contact with water, becomes sufficiently conductive to serve in producing movement currents. I replaced the acidulated water with ether and the insulating medium with a depolarizing medium, two zinc wires, covered with an electrolytic deposit of the same metal and amalgamated, plunge the one into a strong solution of sulphate of zinc, and the other into a stratum of ether placed above a stratum of the same solution (sulphate of zinc). We find then that at the moment when it is passed from the sulphate of zinc into ether the wire is negatively electrified; it becomes positive if moved in the ether, and acquires a positive charge at the moment when it is passed back into the sulphate of zinc; the latter is immediately destroyed by the depolarizing effect of the sulphate.

The electromotive force produced by the movement is analogous to the electromotive force of polarization; it is immediately destroyed in the solution of the metallic salts with which we operate; when the latter are chemically pure and the solutions concentrated, the effects of movement are null. Thus electrolytic zinc does not give a movement current in a somewhat concentrated solution of sulphate of zinc; in a dilute solution of the same salt the effects are very slight, and depolarization takes place when the metal is left at rest. It is the same with platinum chloride, copper in a salt of copper, and silver in nitrate of silver.

We may explain these phenomena by the hypothesis of Helmholtz on double electric strata. According to this hypothesis, at the contact of two heterogeneous bodies, there is formed a double stratum, *i. e.*, a system of two electric layers equal, but of opposite signs, each half of the stratum being attached to one of the bodies in contact. At the moment when the wire is plunged into the liquid the double layer is formed; hence a movement of electricity, which is the immersion current. In the same manner at the moment when the liquid quits the surface of the metal this sort of molecular condenser of which the metal and the liquid form the two coatings is destroyed, and its electricities are set free, whence the immersion current.

During the movement of the electrode in the liquid one part, *m*, of the double stratum, which adheres to the liquid, does not follow the movment of the electrode, and remains on the way, because the liquid is not infinitely conductive. Upon the electrode itself a quantity of fluid, cpntrary to *m*, and which was masked by it, is set at liberty. There is hence produced by the movement of the electrode a partial dissociation of the molecular condenser, which constitutes the double stratum, and consequently the difference of potential upon the coatings is increased; hence the movement current. This explanation has been already given by Professor Helmholtz.

Clocks and Railway Time Tables Changed November 18.

The changes made on Sunday, Nov. 18, in the time by which about all the railroads in the country are run, will be found below. In Boston there is no little opposition to the putting of clocks and watches back some seventeen minutes, as was necessary under the new provision for "Eastern standard" time, but orders were issued for many of the public clocks in that city to be so regulated; and, as the whole railroad system of the Eastern States will be controlled by this standard, the prevailing opinion seems to be that the innovation will be generally accepted. There may be some who will at first carry two kinds of time, the "standard" and the true, as can be readily done by having two minute hands on a watch; this is now frequently practiced to keep both New York and Boston time by those who travel much between the two cities. In New York City, where the change required calls for putting back the true time only four minutes, there will probably be less opposition to the adoption of the new standard, but it may be readily conceived that great confusion will inevitably be caused wherever it is attempted to use the two kinds of time simultaneously.

The time tables of many of the railroads will also have to be changed, as well as the clocks, in order to facilitate the making of connections between lines affected over considerable distances east and west. The following list of changes has, therefore, been furnished by Mr. W. F. Allen, secretary of the railroad conventions, which decided upon the adoption of the new standard, the letter f denoting that the clock is to be set ahead, and the letter s that it is to be set back:

Atchison, Topeka and Santa Fé, east of Dodge City, clocks only, 9 minutes, f.

Atchison, Topeka and Santa Fe, west of Dodge City, clocks and schedules, 51 minutes, s.

Baltimore and Ohio (west), both clocks and schedules, 28 minutes, s.

Boston, Hoosac Tunnel and Western, both clocks and schedules, 4 minutes, s.

Boston and Albany, clocks only, 16 minutes, s.

Canadian Pacific (Eastern division), clocks only, 6 minutes, s.

Central Vermont, both clocks and schedules, 12 minutes, s.

Chesapeake and Ohio, both clocks and schedules, 8 minutes, f.

Chicago and Alton, clocks only, 9 minutes, s.

Chicago and Grand Trunk, both clocks and schedules, 9 minutes, s.

Cleveland, Columbus, Cincinnati and Indianapolis, both clocks and schedules, 28 minutes, s.

Delaware and Hudson Canal Company, clocks only, 4 minutes, s.

Delaware, Lackawanna and Western, both clocks and schedules, 4 minutes, s.

Fort Wayne, Cincinnati and Louisville, both clocks and schedules, 23 minutes, s.

Freehold and New York, both clocks and schedules, 4 minutes, s.

Hartford and Connecticut Western, clocks only, 4 minutes, s.

Lake Shore and Michigan Southern, both clocks and schedules, 28 minutes, s.

Lehigh Valley, clocks only, 1 minute, f.

Louisville and Nashville, clocks only, 18 minutes, s.

Missouri Pacific, clocks, schedules at St. Louis only, 8 minutes, s.

New York, Lake Erie and Western, clocks only, 4 minutes, s.

New York Central and Hudson River, clocks, only 4 minutes, s.

New York City and Northern, clocks only, 4 minutes, s

New York and New England (east of Connecticut), both clocks and schedules, 14 minutes, s.

New York and New England (in Connecticut), both clocks and schedules, 4 minutes, s.

Pennsylvania, New York division, both clocks and schedules, 1 minute, f.

Pennsylvania, all divisions except New York, clocks only, 1 minute, f.

Philadelphia and Reading, both clocks and schedules, 1 minute, f.

Rome, Watertown and Ogdensburg, clocks only, 4 minutes, s.

A tower light is being tried in the South Kensington Horticultural Gardens, London. It is 110 feet high, and supports six Hockhausen arc lamps of 5,000 candle power each.

A new electric arc lamp, invented by F. L. Willard, the novelty of which is the device for controlling the movement of the carbon, has been on exhibition in London.

Oaxaca, Mexico, has the electric light, and the lamps at Merida were first lighted on the 7th ultimo successfully. Guanajuato has added 20 lamps to the installation in the principal plaza.

Aurora, Ill., and Ogden, Utah, are lighted by electric lamps, the power used being that of waterfalls. An electric lighting company proposes to utilize the power of Genesee falls at Rochester, N. Y., and is putting in turbine wheels for the purpose.

At the Dal Verme Theatre, at Milan, recently, an American named Shepherd created a great sensation by appearing with a luminous scarf-pin, which was nothing more nor less than a tiny electric lamp, warranted to go for five hours, by means of a small generator concealed in the waistcoat pocket.

Syracuse, N. Y., is to have a 100-light Thomson-Houston plant, capable of increase to 400 lights.

The Globe Electric Light and Power Company has been organized in Chicago, with a capital of $600,000.

Telephonic.

The Worcester Telephone Exchange.

This exchange was one of the first in New England to open its doors and solicit a general telephone business. When the strife between the Western Union Company and the Bell interest was at its highest point, in the early spring of 1879, this exchange was opened, with Mr. John F. Reynolds, now of the Southern Bell Company, as general manager. In those days the elaborate and almost indispensable telephone appliances of the present were not considered an essential feature of the telephone exchange; in fact, little attention had been given to telephonic appliances, and no inventions had been made, except the telephone itself. An old style Morse switchboard of fifty wires, with cord and plug connections, was ample to furnish telephone facilities for a city of 50,000 inhabitants; one operator, two linemen, solicitor and manager was the force of employes which began to do business, fret over "troubles," and pass sleepless nights trying to make the receipts cover the expenditures, without avail. Then came the struggle for supremacy with the Western Union Company, and to this intense competition is perhaps due the fact that in six or eight months another fifty-wire board was added, and the operative force increased to four day and one night operators, twelve to fifteen linemen, three solicitors, and four inspectors. The exchange, in this prosperous condition, kept growing until it had about 400 subscribers, when the consolidation of the Bell and Western Union interests took place. This gave the exchange about 350 subscribers, or a total of 750. The operating facilities were increased, and a new Western Union pin switchboard, arranged for 320 wires, was put up in a larger room that had hitherto been used for this purpose. Shortly before this, however, Mr. Reynolds had resigned, and the exchange had been purchased by Lowell capitalists, of which D. Osgood Kidder and J. Franklin Harvey were leading spirits and principal owners. Mr. Harvey assumed the management of the new company. The new management was not noted for any startling or brilliant moves, and the property remained about as it had been until it was bought by the present Lowell syndicate, consisting of Mr. Loren N. Downs, Charles J. Glidden and Mr. Wm. Ingram. The syndicate then owned Lowell, Fitchburg, and Worcester, with Mr. Downs as general manager, making the latter city his headquarters. Shortly after this, two more operators were added to the working force, making six day and one night operators. This condition of affairs did not last long, for the business increased rapidly, more room was required, and the switchboard was again moved into a larger room and a 200 wire section added with a working force of ten day operators and three "switch boys" to do the plugging. All this time the system was the old style gravity "battery system," but soon after Mr. Downs took the management it was changed, and the hand generator put in the circuits to call the exchange. This latter system is now used on mixed lines, and the magneto bell on direct lines. Mr. E. M. Wilson, who had been in the exchange from its earliest days, was made assistant manager, and after the syndicate bought the State of Maine Telephone Company, and Mr. Down's field of operations was enlarged, the care of the exchange fell upon Mr. Wilson's shoulders; he was quite competent, however, to manage the business as subsequent events have amply demonstrated. The rapid increase of business for the last year and a half has kept Mr. Wilson and his assistants exceedingly busy. There has been a large increase of subscribers numbering now about 900, and to accommodate them and give good service a larger room was made by taking down partitions and otherwise altering the old arrangement so that the exchange proper is now commodious with room for additional appliances and help whenever it is required. The office and counting rooms are all that is needed to properly conduct a healthy telephone business. Last July the old boards were removed and nine approved Providence switch-boards were put in. These consist of 8-35 and 1-25 wire boards; the former are used for local business, and the latter for trunk line work. On these boards Mr. Wilson uses a device of his own. Instead of the usual jack he has designed a new and valuable "looping-in" arrangement which answers every purpose of the old system with some advantages. The force now consists of eleven well trained operators for the local boards, three of whom are a relief force, with an additional two for trunk line business. Chief among these is Miss Kittie Zaeder, who has charge of the operating room. The other female operators are Misses Grace Hall, Lottie Maynard, Josie Lichtenfels, Nellie Barrett, Addie Berry, Minnie Dagnan, Hattie Lloyd, Annie Riedl. The male operators are Messrs. Sullivan, Healy and Plunkett. The trunk line force are Misses Jennie Eldridge and Lilly Wilder. In the finance department are Mr. W. F. Black, cashier; Mr. E. E. Moore and Miss Mattie Eldridge are the book-keepers of the establishment. Mr. Wilson is now district superintendent, a new title among Eastern managers since the recent consolidation, and in his district are the towns of Leicester, Millbury, Grafton, Holdon, West Boyston, Upton, New England Village, with the central station at Worcester. The total force required to conduct the business is twenty-six, and under the skillful management of Mr. Wilson it is done economically and well.

KANSAS CITY, MO., Nov. 10th.

Editor Electrical Review:

Telephone interests in this State and Kansas have been materially increased and improved during the past six or eight months.

To-day this city has telephone communication with Lawrence and Topeka, forty and seventy miles west of here respectively. Extending north, a line touches at Leavenworth, Atchison and St. Joe, a distance of seventy miles. Then the immediate suburbs of Kansas City, for from four to ten miles out, are connected by telephone placing the citizens of Independence, Westport, Argentine, Wyandotte and Armourdale in close communication with Kansas City, and also with all the cities above mentioned.

This extensive construction has been the work of the present year, and is due entirely to the enterprise and energy of the management of the Missouri & Kansas Telephone Company. When this company was organized last fall, with the exception of Independence, none of the points above named was connected with Kansas City; now the telephone is the chief means of communication between them. The lines are working well and busy the entire day; a number of messages being sent at night. It may interest telephone men generally to know that these lines are constructed of No. 8 galvanized iron wire, every connection carefully soldered, and the poles placed on country roads as far from the railroads and their telegraph lines as it is practicable to set them. These long lines on entering Kansas City are constructed of large Kerite wire, and instead of passing through the cables, which bring all the local lines to the operating room, are brought to the window of the central office, where they pass through the lightning arrestors to the "Extra Territorial" board. This board, connected by trunk lines to the local switch boards, it is the sole duty of one operator to answer, and the increase of the "extra territorial" business is satisfactory proof that the grouping of the toll lines to themselves was very essential to their perfect working.

The United Telephone Company managed by the same gentlemen controlling the Missouri & Kansas Company, has for its territory the State of Kansas (with exception of Atchison, Leavenworth and Topeka) and South Western Missouri. This company has put in several new exchanges, notably: at Rich Hill, Butler and Nevada, Mo., and Arkansas City, Caldwell, Newton, Osage City, Burlingame Junction City, Clay Center and Abilene, Kan.

Quite a network of toll lines has been constructed also, and prosperous Kansas is this year displaying commendable enterprise in keeping abreast of eastern States in the use of time and labor-saving electrical appliances. Lines have been constructed by the United Company connecting Wellington to Caldwell via Hunnewell, a distance of thirty-four miles; Winfield to Arkansas City, thirteen miles, and from there to Genda Springs, eight miles; Ottawa to Osage City, via Pomono, Williamsburg, Quenemo and Lyndon, thirty-three miles; Osage City to Burlingame, nine miles; Rich Hill to Butler, thirteen miles; Abilene to Enterprise and Detroit, six miles; Junction City to Fort Riley, three miles. Besides, there are a large number of instruments in use by individuals and corporations on private lines. The demand is still for more.

The Kansas City Exchange, the largest in this territory, is just emerging from the agonies of "reconstruction," with a much improved system. The new multiple switch board, from the Western Electric Company's Works, has been put in, and is working very satisfactorily. The operating room has been moved to new and pleasanter quarters, and cables—Patterson—used to bring the wires to it, doing away entirely with that multiplicity of wires in the neighborhood that the old "tower" system made necessary. The old poles have been replaced by larger and statelier ones of chestnut and cedar. The work of reconstructing has been expensive and tedious, to say nothing of annoyance to officers and subscribers, as the wires would necessarily get crossed while being transferred from the small poles to the larger ones, and made straight and taut. Through all the annoyance the company has patiently and steadily gone ahead, and now the heaviest work has been completed, and the service is daily improving. At the time of the purchase of this exchange from the Bell Telephone Company, of Missouri, by the Missouri & Kansas Telephone Company, there were two hundred and eighty subscribers, all told. To-day, notwithstanding the eight months past of rebuilding and moving, there are four hundred and fifty subscribers, and nearly one hundred waiting to be supplied with telephones. Does this not speak well of the enterprise of our citizens; and the excellent management of the telephone company? A branch exchange will be built at Wyandotte in a few months. This city is three miles west, and at present connected by a toll line.

Mr. Paul W. Bossart, until recently superintendent of the Kansas division of the United Telephone Company, has had his jurisdiction extended to cover the Missouri division also. Both he and general superintendent E. L. Smith are young men who are making excellent records in telephone circles.

Mr. E. T. Gilliland, ex-president and a leading director of the Missouri & Kansas Company, was in the city recently, and was heartily welcomed by the telephone gentlemen. His new magneto bell is being used exclusively out here, and is praised by all. Mr. Gilliland, it is understood, will soon move to Boston to reside.

Mr. Geo. L. Phillips, assistant general manager of the American Bell, with headquarters in Chicago, is expected in Kansas City next week to make this his stopping place for a few weeks.

The American District Messenger Service of this city has been leased by its owner, the Telephone Company, to the Home Signal Company for a term of five years. The Home Signal has its office with the Pacific Mutual Telegraphic Company, a western corporation owning lines from Atchison and Leavenworth here, and at present just completing a line to St. Louis. The stock is nearly all held by Kansas City parties, I believe. At St. Louis this company expects to connect with the Baltimore and Ohio lines.

A messenger service is to be constructed at once by the Western Union, for the delivery of its messages and the usual work of such organizations. There will probably be considerable competition between it and the Home Signal.

I will endeavor to give you the methods of operating adopted in several of our western exchanges in my next. BI-POLAR.

Telephone connection has been established between Washington and Annapolis and Baltimore and Annapolis.

General Manager Downs of the New England Telephone Company, has removed his office from Lowell to No. 40 Pearl Street, Boston, Mass.

Telephonic communication has been established between Alpnach and the hotel on Mount Pilatus, Switzerland, so that tourists may ascertain the state of the weather on the heights before making an ascent.

The New York Telephone and Telegraph Company has been organized with a capital of $1,100,000 to operate in New York City, and extend lines elsewhere. It is to use an acoustic telephone, which is described as very simple, using no electricity, and capable of being very cheaply built.

Since August 1st, the Nebraska Telephone Company has put up a second wire between Omaha and Lincoln; built lines from Lincoln to Wymore, fifty-four miles; from Lincoln to Milford and Seward; from Lincoln to Crete, and from Ashland to Wahoo, in Nebraska, and from Council Bluffs to Avoca, forty miles, in Iowa. The company has now 420 miles of line, and proposes to open a line from Omaha to Des Moines next month.

The officers of the Tropical American Telephone Company, in a careful review of its business for the past six months, find that the gross earnings from March 1 to November 1 were over $12,000, and the net earnings nearly 8 per cent. on the 40,000 shares of capital on the basis of $3 per share, which is the highest price the stock has reached in the market. For the previous six months, the net earnings were about 6 per cent. on the same valuation. Should a similarly good business be done for the next six months, the managers say, they will probably begin paying dividends on the stock.

The Ellenville (N. Y.) Telephone Exchange is now nearly complete. The wires are strung and most of the machines in place. Everything will be in order for the opening of business on Monday morning next. Headquarters of the exchange are in Masonic Building, second floor. Office hours from 7 o'clock A. M. to 9 P. M. Howard B. Dutcher has been engaged to take charge as local manager, and will assume his duties on Monday. Mr. Otis, to whose energy we are chiefly indebted for the introduction of this improvement, will remain for a time and have general supervision of affairs; also to perfect arrangements for connection with outside lines, concerning which we shall be prepared to give some information next week.

The Bell Telephone Company are building a new line between Boston and New York of No. 12 copper wire, which will be completed about January 1st.

The Rocky Mountain Bell Telephone Company, whose headquarters are at Ogden, Utah, of which J. J. Dickey is president, and A. J. Pattison, vice-president and general manager, have declared their fifth monthly dividend of fifty cents per share, payable immediately. Their next quarterly dividend, payable in January, will be 10 per cent. This company seems to have had a boom since its organization under its present name. Mr. Pattison's electrical energy is plainly seen in its present management, and its large increase in subscribers is due to his untiring efforts. At an early day we shall give a brief history of the remarkable growth of the business in that territory during the two years last past.

Telegraphic.

The meeting of the New York Electrical Society on Friday evening, November 16th, was well attended, and included a goodly number of persons prominent in various branches of the science of electricity. Among them were Professor P. H. Van der Weyde, of the Cooper Institute, and Dr. N. S. Keith.

After the transaction of routine business, the lecturer of the evening, Mr. S. P. Frier, manager of the Wheatstone department of the Western Union operating room, was introduced, and read a very interesting paper on the "Wheatstone System of Automatic Telegraphy."

Mr. Frier began his subject with a brief sketch of all the automatic systems which have been and are now in use by the various telegraph corporations. Bain's system, which was invented in the year 1846, was the foundation of successive systems—good, bad and indifferent. This system was experimentally tried in this country in 1848 and 1849, but was abandoned for various reasons. An Austrian, Dr. Gintl, followed Bain with a system somewhat similar. In 1853 Siemens & Halske, of Berlin, bought an automatic process and equipped lines in Russia with it. It was subsequently superseded by the Morse system. The difficulties encountered in this system led to the introduction of the Siemens polarized relay. This firm and others made innumerable experiments in automatic telegraphy, but not until the advent of the Wheatstone system was anything of a reliable nature produced.

"It was during a visit to Paris," said the speaker, "that in watching the performance of a Jacquard loom, (in which the threads are controlled by perforated paper cards) it occurred to Sir Charles Wheatstone that if the mechanism of a loom could be so regulated, why not electricty? This idea," continued the speaker, "was immediately worked out, and in 1858 he took out his first patent, for what is now so well known as the 'Wheatstone System."

Its working parts consist of a perforator, in which the paper is prepared for the transmitter; the transmitter which uses the perforated paper for the purpose of transmitting the currents of electricity, and the receiver for recording upon paper the results of such electrical transmissions.

The speaker then described in detail each instrument, using diagrams to illustrate special parts of the mechanism not well understood by a mere verbal description.

The development of the Wheatstone system in Great Britain and Ireland during the past five or seven years, has been the most rapid of any system, and now all the circuits are worked at an average speed of 200 words per minute. It is growing in favor on the Continent. The minister in postal telegraphy in France has established at the central office a special course of lectures on Wheatstone's automatic apparatus to which competent operators are admitted.

"One of the great uses to which this system is particularly valuable," said Mr. Frier, "is that of working extremely long wires. Experiments are at present carried on in working the system duplex on a wire one thousand miles long through one repeater, and the speed attained is an average of nearly 150 words per minute—an equivalent to 600 messages per hour, 30 words per message. It is just a question of time when it will be working quadruplex. Like all other systems that have for their object the disposal of many messages over one wire, the Wheatstone requires skilful handling, and the repeaters have to be under the control of experienced electricians to obtain their full working capacity. A skilled mechanician is also an important requisite in this system The Western Union have in their employ one of the best they could get from England. Another great advantage of the system is that the paper for receiving does not require any preparation after leaving the hands of the manufacturer."

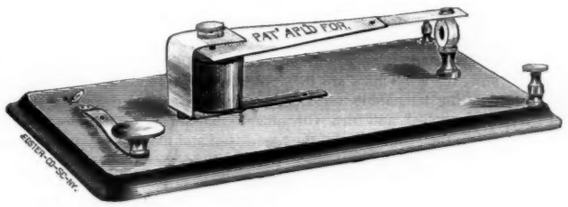
In conclusion, Mr. Frier stated that every town in England which has a morning newspaper has a Wheatstone circuit. London is the fountain head of the service, and an average of one million words per night are handled here. One punched slip will feed as many transmitters as necessary. Three slips are often punched at once by the perforator, thus supplying matter for three separate wires.

There is no political, congressional, or other public meeting that has not a trained staff of Wheatstone operators. Every race meeting has its Wheatstone staff, without which, at such places as Epsom, Lincoln, Newmarket, etc., the business could not be handled. At the former, on Derby Day, fifty thousand or more dispatches are handled in within an hour or so of the result of the race.

A complete set of the apparatus, which had been placed on the platform for the occasion, was then put in actual working order and examined with evident satisfaction and pleasure by the members. The scene was a lively one for a time, resembling a junior telegraph office. The beautiful workmanship displayed in the finish of the instrument elicited general expressions of admiration.

The next meeting of the society will be held on Friday evening, December 7th, at which Mr. P. B. Delany, of Philadelphia, will deliver a lecture on "Synchronous Multiplex Telegraphy." This is the system recently invented by that gentlemen, and given much publicity through the daily press.

The Southern Times Telegraph Company has been incorporated at Nashville, Tenn., to operate in the Southern States.



Lockwood & Foster's Telegraph Sounder and Hinged Key.

This new sounder and key, which we illustrate in to-day's issue, will be found worth investigating. It has been tested and indorsed by prominent operators and electricians of the Western Union and other companies, and we think it will meet with a ready sale.

The advantages of this new sounder and key are:

1st. The self-adjusting armature, which is a metal-plate armature balanced on a plate spring, the sound of which is regulated by the small screw over the helix, so as to be loud enough to read a message a great distance from the instrument, and be heard distinctly above the sou.d of any other instrument in the room. Thus it is plainly seen that the trouble of balancing the armature of the sounder is entirely obviated.

2d. The hinged key is constructed in such manner as to close the circuit and clean its connections by throwing it back against a metal arm, and at the same time exposes the connections underneath the key, which complete the circuit through the sounder, from which connections the oxidization may readily be removed.

3d. It is readily seen, at a glance, that the construction of this instrument is by far simpler than that of the "Morse" or any other telegraph instrument now in the market, thus enabling the inventors to furnish this instrument to the public at less than one-half the cost of any other.

The Bankers & Merchants' Telegraph Company has declared a dividend of 2 per cent, payable December 12 to stockholders of December 1. Stockholders of date will be privileged to subscribe for $1,000,000 of new stock at par. The stock of this company is selling at 137¼@137½.

Postal Telegraphy.

JOHN MACKEY ON THE NEW SCHEME—HE IS DETERMINED TO GIVE THE PUBLIC CHEAP RATES.

John Mackey was recently interviewed by a reporter of the *Carson Appeal* in Nevada. He talked freely on the subject of postal telegraphy, as is given below:

"We have started several lines, and our factory in Ansonia, Conn., is turning out fifty miles of steel and copper wire a day. The wire is copper, with a steel core running the center to give it strength. It will last for years. Look at these old iron wires. They wear out, and it keeps men repairing all the while. They are of very little account. Our wire is a world-beater.

"Between New York and Chicago we send 500 messages a day with four operators under the new system. The dispatches are fixed on a cylinder, and then it goes like a flash. We charge twenty-five cents for twenty words, and my idea is that such tariff is too high. There is big money in half a cent a word. I hope to see the tariff reduced to 12½ cents for twenty-five words. The greatest expense is the delivery, and we expect to adopt a system by which the dispatches can be turned over to the post-office and put into the delivery boxes the same as letters. By combining the postal telegraph with the post-offices in large cities, we can give the public the cheapest system for the area of country covered in the world.

"We intend to pay the highest wages for skilled labor, and I consider that a telegraph operator must be a man of the highest intelligence. Some of the Western Union men who have grown old in the service get $40 a month. Our new machines are labor-saving, and we can afford to pay the best wages. We can handle ten times the amount of business that the Western Union can, and will make that extra business by placing telegraphy where poor men can use it."

The New England Telegraph and Telephone Company completed its organization at the Metropolitan Telegraph and Telephone office, New York, last week: T. N. Vail, president; W. A. Ingham, vice-president; Wm. R. Driver, treasurer; C. J. Glidden, secretary, and L. N. Downs, manager. The directors are W. H. Forbes, of Boston; Fredk. Ayer, of Lowell; Stephen Salisbury, Jr., of Worcester; Theo. N. Vail, of Boston; W. A. Ingham and C. J. Glidden, of Lowell; Chas. P. Bowditch, Alexander Cochrane and J. E. Hudson, of Boston. The Executive Committee remains to be chosen. The headquarters of the company are to be at 40 Pearl Street, Boston.

A General Setting of Clocks.

THE TIME OF THE COUNTRY TO FORM IN COLUMNS OF FOURS NEXT SUNDAY.

On Snnday, the 18th inst., the four standard times, which are to take the place of the fifty-three kinds of time now used in the United States, will go into effect on most of the railroads and in many cities. In some places the clocks will be changed at five o'clock in the morning, and in some at noon. The majority will be changed at the latter hour. Circulars are being issued by the railroad companies announcing the change and providing for all details.

Mr. W. F. Allen, the Secretary of the Railroad Times Convention, was asked yesterday if the announcement of the Illinois Central Railroad that it would not adopt the new standard time on its long line running from Chicago to New Orleans, unless it was adopted in the city of Chicago, would prove a serious obstacle to the general adoption of the standard time. Mr. Allen said that it was perhaps unfortunate that the railroad company had not seen its way to adopting the new standard, but he thought that there was a possibility that its action might be a movement intended to assist in securing the adoption of the standard time by the city council of Chicago. He said that there was no large city in the Union better placed than Chicago to adopt the time of the 90th meridian.

Movements are on foot in many large cities to secure the adoption of the new standard time by the local authorities. Bangor, Maine, has adopted it, although there is 20 minutes difference between Bangor time and the 75th meridian time. It is said that Baltimore will adopt it this week. Benedict Brothers, of New York, announce that at noon on Nov. 18 all the clocks in their charge will be set back three minutes fifty-eight and a half seconds.

The Cleveland Electric Company is a new organization, with Messrs. S. E. Henderson, president; W. H. Gabriel, secretary; J. L. Athey, W. P. Chard, W. E. Craig, D. H. Kimberley and H. W. Kitchen as directors, and with capital stock of $100,000. Mr. C. O. Evarts is treasurer. The company will fit up a factory on the flats for the manufacture of motors for sewing machines, denta lathes, and of electric light apparatus.

Postal Telegraph Changes.

A meeting of the stockholders of the Postal Telegraph Company has been called for Saturday, Dec. 1, "to consent by a formal vote to the sale of their property, rights, and interests" to the Postal Telegraph and Cable Company. Secretary George R. Williamson gives public notice that already more than three-fourths of the stockholders of the Postal Telegraph Company have consented in writing to the sale, in accordance with the terms of an agreement dated Nov. 3, 1883. The Postal Telegraph and Cable Company was incorporated about the middle of last month by Henry C. Gardner, Luther R. Marsh, Andrew W. Kent, Dumont Clarke, and T. H. Dupuy. The amount of its capital stock was placed at $1,500, with the privilege of increasing it. At the time the articles of incorporation were filed Mr. Gardner said to a *Times* reporter: "Our charter has been made as comprehensive as possible, and we hope to combine under it nearly all, if not all, of the telegraph companies outside of the Western Union." The Postal Telegraph Company has already conveyed to the Postal Telegraph and Cable Company, by an instrument recorded in the Register's office yesterday, all its telegraph lines extending from this city to Chicago, franchises, etc. The document recites that in consideration of $10,498,500 in full paid shares of the capital stock of the Postal Telegraph and Cable Company of the par value of $100 each, the Postal Telegraph Company has executed this conveyance.

The Southern Telegraph Company.

AUGUSTA, Ga., Nov. 20.—The Southern Telegraph Company's line has been completed to this city, and is working with Richmond, Baltimore and intermediate places.

The Globe Telephone Company of New York has bought the Shaw patents.

Microscopes have been tried with the Swan incandescent lamp, instead of the ordinary oil one, and with marked success. A small lamp of two or three candles in power is rigidly attached to the microscope, and then the current is sent through at will, giving a pure light without any of the drawbacks of great heat, smell, unsteadiness of any kind, or any necessity for cleaning.

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We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Those desiring to recommend their goods can do so to any extent in our advertising columns, but we will not publish for pay anything of that nature in our reading columns.

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NEW YORK, NOVEMBER 22, 1883.

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Telephonic Methods and Improvements.

The two rival telephone companies of London had a partial understanding some time since, yet the establishment of telephone lines in the British metropolis is very slow; and, if the reports which come to us from time to time may be relied upon, those already established give but little satisfaction. The truth is that those who control the telephone system on the other side of the water have adopted the defects but not the virtues of the system in vogue here. They buy up rival systems and improvements, in order to be as free as possible from competition, but refrain from making use of those improved mechanisms by which alone an efficient system of telephonic communication can be maintained.

We will not deny that this system of squelching aspiring genius, adopted from the pattern we set them, is pernicious, and yet it must be confessed that here, in America, the public has been the gainer by its adoption. Efficient telephonic exchanges were started here much earlier than in the old country, and rival claimants have never possessed the power, as they have in England, of so interfering with each other as to make the efforts of both to establish telephonic communication inoperative.

In a paper read by Mr. Preece, at a recent meeting of the British Association, on telegraphic intercommunication, the opinion was expressed that when attacks as to the validity of the telephonic patents ceased, it would be found that the system employed by the post-office was so superior to that which the companies are trying to adopt, that the latter would find it to their advantage to use it. He added, in a vein of sarcasm, that there was little likelihood that the post-office switchboard would be adopted, for the reason that it had *not* been patented.

As things go now, the Londoners are far from satisfied with the telephonic service with which they are supplied, and turn with envious eyes toward their fellows in the provinces, who are served by the post office authorities with an almost perfect system.

The English *Mechanic*, which would seem to have looked very carefully into some of the later inventions, thinks that some of these are bound sooner or later to work their way into popular favor—that is, should the claims of their inventors for originality be sustained by the courts. There is, for instance, Professor Dolbear's static telephone, which many electricians are inclined to view with kindly eye. This telephone is little affected by induction and the elements, and is already tolerably well known.

At a recent meeting of the American Association, this instrument was the subject of animated discussion. The system employed by Professor Dolbear dispenses with magnetism and a return circuit, the body being taken as the equivalent. A chief drawback, however, may be found in the fact that it requires a large electromotive force and an induction coil of 2,000 ohms.

From plate to plate there is no passage of electricity, the action through space being inductive; the insulating being effected by the intervening air and a coating of varnish; and, if the conditions are perfect, the receiver may be entirely disconnected from the transmitter, and even then intelligible sounds can be heard across a room. This is one of the systems in which the *Mechanic* has great confidence, and it virtually claims, with Professor H. A Rowland, of England, that this Dolbear instrument is entirely different in principle to the magnetic telephone.

Another system which has attracted not a little attention in England is that of a Mr. A. F. St. George, who claims for it that messages can be transmitted long distances with very little interference from inductive action, and with much ease in working. The instrument is thus described: The transmitter consists of a disk of carbonized wood or other suitable organic matter, which is resonant and capable of transmitting electricity. This disc is supported in a frame having an aperture to direct sound waves on to one face, while behind it hangs by a fine metallic wire a ball of very hard carbon. This ball touches slightly against the disk; and when the latter is vibrated by sound waves, the former makes little excursions over the disk, thus bringing fresh points of contact into use. The connections are made in the usual manner with a battery and the primary wire of an induction coil. So far, there is nothing very novel in the arrangement, nor in the receiving instrument, which consists of two or more disks of mica, arranged parallel with each other in close order, and mounted at their edges in such a way that they are free to vibrate. One side of each disk is coated with metal, preferably silver, and it is advantageous to perforate the disks at the center.

The disks are arranged with their metal faces looking in one direction, and are connected alternately with each other; one set being attached to one wire of the circuit, and the other set to the other wire. This condenser arrangement is believed to increase the audible effects produced by the receiver. What might be called the remarkable feature of Mr. St. George's invention is the recording receiver, which is intended to reproduce, at any distance and at any time, the sounds originally transmitted to it.

The apparatus which enables it to do this is thus described: "It consists of a flat, transparent disk of glass, which revolves at a uniform speed. One surface of this disk is coated with a film sensitive to the action of the light ordinarily known and used in photographic processes," and the whole arrangement is placed in a dark chamber. An aperture or lens is provided, through which a beam of light can pass and fall upon the surface of the sensitized plate in any desired position, and the aperture is so arranged in connection with the sensitized plate that a beam of light is made to trace a spiral line on the surface of the latter.

This spiral line will, so it is said, vary in width in exact proportion with the character and strength of the vibrations of the telephonic diaphragm. The sensitized plate is developed and fixed in the usual way, and is then ready to reproduce the message at any time. That is done, or is said to be capable of being done, by passing a beam of light through the glass plate to a selenium receiver, by means of which undulations are produced in an electric current and reproduced as audible sounds in a telephone receiver."

Mr. Johnson's Opinion of Mr. Whiting and of the Storage Battery.

The charge that we made two weeks ago and reiterated in our last number, viz., that the attack on the arc system of lighting, or, rather, on the Brush system, was encouraged, if it did not originate with the Edison Company, was partly corroborated last week in the appearance of Mr. Edison and E. H. Johnson, of the Edison Company, as witnesses in a suit against the Brush Company.

The casual observer has, no doubt, wondered why the Brush Company's poles in 25th Street should so annoy Mr. Edison, who is at the head of the Edison Electrical Company, and Mr. Johnson. Those, however, who are familiar with electrical enterprises hereabouts are aware that it is not the Brush Company's poles that annoy the Edison people, nor their arc light by itself considered. It is the combination which the Brush Company have made, by which the arc wires are made to charge the secondary batteries, which in turn are to supply the Swan incandescent lights. We cannot say that we had any great confidence in this system, since it has not yet been tried on a large scale, until the Edison people exhibited symptoms indicative of an impending stampede. No better evidence could be had of the efficiency of this new system of incandescent lighting than the fact that its chiefest rival is up in arms against it, and that even Mr. Edison, who has usually abstained from taking a hand personally when rival interests were concerned, should appear in court in the thin disguise of a witness for the plaintiff.

By the testimony in this case one would be led to believe that, though the arc wires have been up for several years, it had just been discovered that they were dangerous. All this time the Edison people would seem to have stood by in silence while these wires were "threatening the lives of the public," and offered not a word against them until they were made part of a system which threatened the usefulness of their own, and then, to use a Wall Street idiom, "they squealed."

In last week's trial Mr. Johnson, who, by the way, seems to be a very eminent electrician in his own estimation, though we must confess we never heard of him save as an officer of the Edison Company, repeated and reiterated the ridiculous statement that water from a hose, tapping an arc wire, would kill the firemen.

Now this, like some other statements made by the alleged scientist, is bosh and twaddle. The first principles of that science in which he professes to be proficient should have taught him that this was not true, and that water, though by no means the best conductor, offers, nevertheless, a less resistance to the passage of the current than does the human body, and hence the current will not leave it for the human body. If, however, this and kindred statements were made only to hoodwink the public, frighten the firemen, and thereby create a prejudice against a rival company, the spirit that prompted them is beneath contempt, and our only surprise is that a reputable company should have sanctioned such devices.

After our greatly esteemed contemporary, the New York *Times*, had published its interview with an "eminent" electrician, in which the storage battery, as well as the arc light was assailed, Mr. Elliot B. Whiting, who has had long experience with storage batteries, was so bold as to offer a feeble protest against at least so much of it as concerned them.

This letter being shown to Mr. Johnson would seem to have created a variety of sensations in the breast of our newly discovered electrician, for it appears that in his estimation, only the Edison Company or himself, its representative, are warranted in having an opinion upon the storage battery. "I know who this man Whiting is," says Mr Johnson, as if the fact that he knew him made him unreliable. "He is not an electrician at all. He knows nothing about electricity beyond what somebody else has told him.' It is a terrible charge against Mr. Whiting that of only knowing what he has been told. He ought to have made some unique discoveries on his own hook, as Mr. Johnson evidently has, and drawn on his imagination liberally, then he might possibly be more favorably regarded by the latter and be spoken of with something less of contempt than is indicated in the term "this man Whiting."

Dr. C. W. Siemens and his two brothers, than whom no more eminent and trustworthy electricians are to be found, have adopted the storage battery, and sing its praises far and near. So does Sir William Thomson, so do Professors Ayrton and Perry, so does Prof. Sprague, and so do the most learned and reliable authorities in England and on the Continent of Europe. But we suppose that our new American electrician, Mr. Johnson, would only reply to this, "I know this man Siemens, and this person Thomson, and one Sprague—all they know about the storage battery some one told them." Listen to Mr. Johnson on the storage battery :

"If there was a pressure of 1,000 volts on the arc wire, and there were 250 cells being charged, after the wire was removed there would be a pressure in the battery of say 500 volts, which might not be fatal to life, but certainly would be dangerous. If there were, say 425 cells, then they would have near the same pressure, after being disconnected, as the arc light wire had, which would certainly be fatal. Take a theater, for illustration, where they have 500 lights, they would require 20 boxes of 20 cells each, and those would have to be charged at a pressure of about 1,000 volts. When left standing they would have a pressure of about 900 volts. They are then deadly, and will be so until their pressure is lost by leakage or until they are switched into the multiple arc

system, which will reduce their pressure to 300 volts or even as low as 50 volts. To say that electricity stored in a storage battery is different from all other forms of electricity in that it will not give a shock, the violence of which is dependent upon its pressure, is simply damned nonsense."

Then he goes on to say that he knows "this man Whiting," (Mr. Whiting's offense is that he said the storage battery was harmless), and ends by extending the polite invitation to Mr. Whiting to connect 500 Faure batteries, assuring him that when he has done so "he will be as dead as a door nail." On the part of Mr. Whiting, this invitation is hereby declined. We have not the pleasure of his acquaintance, but we know he would glady authorize us to take this action.

We dare say that Mr. Whiting is aware that this would be the result of joining five hundred Faure batteries, for he has given evidence of the possession of more accurate knowledge of secondary batteries than seems to be possessed by that eminent electrician, Mr. Johnson; although, in the somewhat inelegant but forcible language of Mr. Johnson, his assertion that the storage battery is harmless, is "damned nonsense." But let us see what the joining of five hundred Faure batteries has to do with the issue before the court, which, if we understand it correctly, was simply whether the storage battery is dangerous when used in the manner proposed, viz.: for incandescent lighting.

Mr. Johnson has told us that, in the lighting of a large theatre, where five hundred incandescent lights are used, only twenty boxes of twenty cells each are required, and the necessary charge for these would be but 1,000 volts., and that when switched into the multiple arc systems the pressure that these would have would be reduced to three hundred volts, or even as low as fifty volts. Thus it will be seen that Mr. Johnson, in order to prove his point against a rival system, takes an extreme case as an example of its defects.

In the system by which it is proposed to light up dwellings, offices, &c., by incandescence lamps connected with storage batteries, such a battery power as is here spoken of would be phenomenal. Dwellings that require fifty lamps, or stores that require one hundred lamps, are by no means plentiful; yet the one would necessitate a battery power of only a tenth of that described, and the other but a fifth. Hence might "this man Whiting" give his critic, Mr. Johnson, the retort direct, and the expressive but inelegant phrase of the latter, "damned nonsense," might be employed to characterize his own statement concerning storage batteries.

It was a cold day—the first day of the trial; but the thermometer, though registering 30° Fahr., must have appeared, in the eyes of Mr. Johnson, to have by no means indicated how cold the day really was when, upon closing his testimony against the storage battery, showing how useless and dangerous it was, and returning to his office he was shown the following dispatch:

"LONDON, Nov. 13.—The Edison Electric Light Company have purchased the right for the Faure-Sellon-Volckmar storage batteries for certain districts."

What would he not have given to take back what he said about the storage battery? Not that a part ownership by his company would make the dangers and the defects of the storage battery any the less; it would not alter its chemical inequalities, its leakages, to use a popular though incorrect term; but it doubtless possessed some virtues to offset these and other defects, which a careful examination would reveal.

His superior, Mr. Edison, however, gave way to no such lamentations. He boldly took the bull by the horns, and denied the story *in toto*. Mr. Edison told a reporter who questioned him concerning the dispatch, that it was untrue. It was, he said, only a scheme to boom the Faure stock.

This contradiction of Mr. Edison's, of the London dispatch, led Mr. J. I. Courtenay to telegraph to London for information. The Faure-Sellon-Volckmar accumulator is owned by the Electrical Power Storage Company of London, and Mr. Courtenay represents their interests in this country. He knew that his company had been negotiating with the Edison Company in Germany; and in reply to his demand to know the facts, he received a dispatch stating positively that the rights had been sold to the Edison Company. Yet Mr. Edison has told us that the only use for the storage battery was to bring out man's innate capacity for lying; that the storage battery was of no earthly use save as a snare by which capital might be trapped, &c., and his Mr. Johnson, has told us that the storage battery is deadly, and the old and the young, and no doubt the innocent babe, is in imminent danger from its use.

This cable dispatch created, no doubt, as much consternation as a bull in a china shop. It could not have arrived at a more inopportune time, unless, perhaps, about a year ago, just after Mr. Edison described the usefulness of the storage battery to a Boston *Herald* reporter.

But, now, that it should come just at the time when Mr. Johnson was describing its defects to the public, is too much. Hereafter Mr. Johnson should be kept back and not allowed to state his views publicly, until an authoritative statement of all purchases has been received from the London office. Then, and then only, will it be possible to prevent the recurrence of that peculiar phenomenon in commercial affairs, by which one end of a company engages in disparaging to the public what the other end is occupied in purchasing.

The Course at Cornell.

It was announced last spring that Cornell University would, at the opening of the fall term, receive students for a course of instruction in electrical engineering. The announcement has created so much interest, and provoked so much inquiry, that we have endeavored to procure and present to our readers full information in regard to this new department of study.

The requirements for admission are the same as to the other technical courses, civil and mechanical engineering, etc., that have been so long established, viz.: algebra and geometry, in addition to the common English branches.

The course in the university includes the higher mathematics, the French or German language, rhetoric, descriptive geometry and mechanical drawing, physics, chemistry, the steam engine and other motors, besides the special work in electricity, which constitutes the special features of the course.

The instruction in electricity includes the use of all the instruments employed in making electrical measurements, with the means employed in testing their accuracy, and determining their constants; the construction and testing of telegraph instruments; the methods of testing telegraph lines and cables; the theory, construction, and testing of dynamo machines; the study of the different systems of electric lightning, etc., etc.

The course is designed to give a thoroughly practical, combined with a theoretical training, and the electrical engineer will find use for every subject named. The higher mathematics and pure sciences will be found of especial importance, now in the infancy of the applications of electricity, when so much is in the tentative stage.

The facilities for this institution at Cornell are of the best. A large new building has just been completed, in which are several rooms specially equipped for electrical tests and measurements. All the important instruments for measurements are provided. Dynamo machines and systems of electric lighting are in practical operation in the building, and, as far as possible, all the applications of electricity are exemplified.

The student spends a considerable portion of his time in the laboratory, making experiments with the various instruments. He determines the laws and constants of galvanometers; measures the resistances of various conductors; measures the currents used for electric lights; determines the energy expended in charging, and that developed in discharging storage batteries; determines the efficiency of machines and motors; in short, does exactly what the engineer needs to do in the factory or office.

Electrical Notes.

The study and comparison of electric lights implies the use of a photometer to measure the comparative intensities of different lamps.

***

The ordinary apparatus is available only in a laboratory, and a small meter that could be carried in the pocket would prove of value.

***

Such an instrument has been devised, and may be briefly described.

***

It consists of a small square box or frame, open at two opposite sides and the top.

***

The sides are covered with opal glass, care being taken to cut the glass from the same sheet, so that both pieces will be of equal translucency.

***

On the top of the box is fitted a small telescopic tube, having a lens at the end, the whole being, of course, light-proof, except at the glass sides and the lens.

***

Within the box are two small mirrors, or two pieces of white cardboard, placed at a right angle with each other and forming a prism, the point or edge of which is opposite the lens.

***

On holding the instrument between the two lights to be compared, each side of the prism is illuminated through the glass end.

***

When the prism, seen through the lens, appears to lose its appearance of relief, or to be equally lighted on both sides, the two lights are equal at that point.

***

By comparing the distance between the observer and the two lights, their comparative photometric value can be estimated according to the usual rules.

***

The chief point of novelty in this apparatus is the use of the lens and telescopic tube, which makes it possible to reduce the photometer to a convenient size for the pocket.

***

The most recent experiments that have been made to meet the growing demand for low motive power in small shops and manufactories, turn upon the familiar idea of moving air through pipes.

***

Unlike the distribution of compressed air through pipes, the new system employs the natural pressure of the atmosphere as the direct source of power, and an exhaust or suction air-pump, driven by a steam engine, as the indirect source.

***

At the central station powerful air-pumps have been set up and provided with steam power.

***

Wrought-iron pipes, having rubber joints, are laid in the street to form the main, and from the main smaller lead pipes are laid into the buildings where power is wanted.

***

Upon each lathe, drill, sewing machine, or other tool, is placed a small oscillating motor, connected with the tools by means of belts.

***

Each motor stands upon a hollow, cast-iron stand or reservoir, that is connected with the air-pipe from the street.

***

The air needed to move the motor is admitted directly and by means of a simple stop-cock; that in the case of a sewing machine or lathe can be controlled by the foot-pedal, thus leaving the hand free for the work.

***

The admission of the air is cut off before the stroke is completed, and the air is allowed to expand in the piston.

***

The exhaust is allowed to enter the reservoir under the motor and is then drawn into the pipe.

***

Oil or dust that might clog the pipes is caught in the reservoir, and can be removed as it accumulates.

***

It will be seen that the plan is a negative one.

***

It is not the positive transmission of power, but the creating of pressure in the cylinder of the motor by creating a vacuum at the exhaust.

***

So far the experiments have been limited to a comparatively small space, the mains being only six hundred metres long.

***

The mains are six centimeters (about two inches) in diameter, and the service pipes much smaller.

***

The power developed in the motors is low, the design being only to furnish light power for small shops, houses, &c.

***

The experiments already made appear to be satisfactory.

***

Notwithstanding all this, there is good reason to believe that the electric motor driven by a gas engine will be adopted in the future as the most efficient and economical of all motors.

***

Speaking of motors and means of driving them, I am reminded of a new steam boiler from which much is expected.

***

It is of the upright, tubular type, and is made in two parts, a round chamber containing the grate, and forming the fire box, and a steam and water space immediately above it.

***

The products of combustion pass upward through this upper portion of the boiler through vertical flues that open into the smoke stack above the boiler.

***

This part is not essentially different from other types of upright tubular boilers.

***

The novel feature is an annular water space, extending entirely round the ash pit, and just below the level of the grate.

***

This water space is connected with the boiler above by two systems of pipes placed in rings round the fire.

***

The inner circle is next the grate, the pipes being placed close together and bent toward the center, and forming a cone-shaped cage round the fire.

***

The outer circle of pipes is upright, and placed next the outer casing of the boiler.

***

The outer pipes, being shielded from the fire by the inner circle, are less exposed to the heat, and consequently the tendency of the water is downward.

***

In the inner circle the movement of the water is upward.

***

By this arrangement a circulation is maintained and all sediment is deposited in the colder annular space below the fire, from which it may easily be withdrawn.

The introduction of electricity as a substitute for lamps and candles on board ship is making rapid progress. There is one source of safety in this to the ship and the passengers. All lights are put out at eleven o'clock. After this time people may talk in the dark, but there is no possibility of the reckless use of lights and lamps.

The Armington and Sims Engines.

This company has recently shipped engines to be used in connection with electric lighting to Berlin, Germany, and London, England. It has furnished the engines to be used in the Edison central station at Lawrence, Mass., which will be opened next week. The company has also closed a contract with the Edison company at Fall River for supplying its stations with engines, and will ship at once to St Louis, for electric-lighting purposes, by the Edison Company, six engines which are duplicates of those used in the Brockton lighting station, and one to the Fall River Edison Electric Light Company. Aside from the Armington & Sims Company supplying these engines for electric lighting purposes, it also builds many engines for general manufacturing purposes. In this connection it has recently put in a 200-horse power engine at the Pequot Mills, Montville, Ct.; one of the same size at the Arkwright Mills, Harrisville, R. I.; one 92-horse power engine at the Methuen Mills, Methuen, Mass., and has sold to the Russell Paper Company of Lawrence, Mass., one 150-horse power engine, making five to this company. The Nourse Mill, Woonsocket, R. I., is putting in a 9½x12 engine to run their Maxim incandescent lights. This engine will run direct, being connected with the dynamo-electric machine by two belts, and no shafting or pulleys will be used. The original intention was to put in a long-stroke Corliss, but it required double the room, and it cost, with larger foundation, shafting, and pulleys, just double the price of the present plant.

The Honorable William Maxwell Evarts and the Honorable L. E Chittenden are having a tremendous electrical struggle in Judge Ingraham's Court. As neither gentleman knows a horseshoe magnet from a differential galvanometer, or can tell the difference between a farad and a streak of lightning, the battle is one of unusual interest. Mr. Chittenden is retained to believe and urge that the electric light wires strung along Twenty-fifth Street are pernicious to life, and that one of them, dropping upon the tail of a full-grown dog would be powerful enough to kill a man. Mr. Evarts, on the contrary is of the paid opinion that a 4,000 volt current is the proper thing for babies to play with, and denies with vigor any assertion to the contrary. We do not presume to dictate to either of these gentlemen, but in the interest of science would it not be well for Mr Evarts to try the experiment of grasping both wires of a dynamo while the current was on? There is considerable doubt on the subject, and Mr. Evarts should settle the question at once. He has a noble opportunity.—*Life.*

A second electric boat, forty-six feet in length and capable of carrying fifty passengers, has recently been launched on the Thames. The motive force lies concealed in seventy boxes, each of one-horse power, stored under the floor of the boat, and at the end there is a Siemens dynamo, the spindle of which is continued so as to form the screw without intermediate gearing. A speed of nine miles an hour can be maintained for six or seven hours, when the secondary batteries have to be replenished. There is no noise, nor heat, nor smoke, nor waste, and the machinery takes up so little room that practically the entire boat is available for passenger accommodations.

NEW PATENTS—ELECTRICAL—1883.

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING NOVEMBER 13, 1883.

288,570 Electric hotel annunciator and fire alarm; Albert T. Hess, Des Moines, Iowa.

288,202 Polarized electric bell; William J. Bowen Norwalk, Ohio, assignor to himself T. T. Keckeler, Cincinnati, Ohio, and Z. C. Thwing Marshall, Michigan.

288,496 Electric clock; Jean Paul Arnold, Schlaefli Soleure, Switzerland.

288,315 Apparatus for regulating electric currents; Sebastian Ziani de Ferranti, Richmond Gardens, Shepherd's Bush, and Alfred Thompson, Guildford Place, Russell Square, County of Middlesex, England.

288,393 Current regulator for electric light circuits; Craig R. Arnold, Philadelphia, Pa.

288,316 Dynamo-electric machine; Sebastian Ziani de Ferranti, Richmond Gardens, Shepherd's Bush, and Alfred Thompson, Guildford Place, Russell Square, County of Middlesex, England.

288,318 Regulator for dynamo or magneto-electric machines; Thomas A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y.

288,536 Electric signal box; John C. Wilson, Boston, and Milton G. Davis, West Somerville, Mass.; said Davis assignor to said Wilson.

288,555 Conduit for electric wires; Bernhard A. Dryer, New York, N. Y.

288,311 Subterranean line of electric wires; Henry B. Cobb, Wilmington, Del.

288,310 System of laying subterranean lines of electric wires; Henry B. Cobb, Wilmington, Del.

288,443 Compound electric conductor; Lennon Johnson, Vincennes, Ind.

288,556 Electric signal; Edward Dummer, Boston, Mass.

288,454 Machine for insulating electrical conductors; John Kruesi, Brooklyn, assignor to the Electro Tube Company, New York, N. Y.

288,360 Telegraph insulator; Samuel Oakman, Melrose, Mass., assignor to the American Insulator Company, of New York.

288,346 Electric lamp; Edward R. Knowles, Brooklyn, N. Y.

288,217 Contact for electric lamps; Henry Edmunds, Jr., New York, N. Y., assignor to Thos. J. Montgomery, Boston, Mass.

288,218 Contact for electric lamps; Henry Edmunds, Jr., New York, N. Y, assignor to Thos. J. Montgomery, Boston, Mass.

288,215 Telephone; Amos E. Dolbear, Somerville, Mass., assignor by mesne assignments to the Dolbear Electro Telephone Company, of New Jersey.

288,320 Adjustable telephone holder and automatic circuit breaker; William H. Eckert, John A. Seely and Edward A. Eckert, Cincinnati, Ohio.

288,449 Telephonic apparatus; John H. Kinsman, Rye, N Y

288,366 Apparatus for telephonic communication; James H. Rogers, Washington, D. C., assignor by mesne assignments to the American Electro Gas Telephone Company, of New Jersey.

Telephone Stock Quotations.

American Bell Telephone Company	192
Bay State Telephone Company	123
Central New York Telephone and Telegraph Company	101
Boston and Northern Telephone Company	135
Empire State Telephone and Telegraph Company	200
Granite State Telephone Company	95
Hudson River Telephone and Telegraph Company	100
New York and New Jersey Telephone Company	85
Mexican Telephone Company	3¾
National Bell Telephone Company of Maine	90
New York and Pennsylvania Telephone Company	80
Northwestern Telephone Company	100
Southwestern Telephone Company	68
Suburban Telephone Company	139
Southern Bell Telephone and Telegraph Company	125
Tropical Telephone Company	2½
Central Union Telephone Company	100
Iowa Union " "	100
Missouri and Kansas Telephone Co.	90
United Telephone Company (Kansas and Missouri)	89
Bell Telephone Company, of Missouri	165
Wisconsin Telephone Company	125
Cumberland Telephone Company	100
Great Southern Telephone Company	100
Michigan Telephone Company	115
Chicago Telephone Company	285
Erie Telephone Company	59
Union Telephone Company	100

The Car Builders' Club, of New York, has chosen the subject for investigation and discussion at their March meeting, Whether it would be practicable or economical to light cars with electricity or gas; also an inquiry into improved heating and ventilation.

The ELECTRICAL REVIEW for November 1 has an illustrated article on batteries and accumulators, besides telephonic, telegraphic, and electrical information. Published at New York.—*Evening Standard,* Nov. 8.

BUSINESS NOTICES.

The Chrome Steel for Magnets, &c., Endorsed by Electric Light Companies.

[COPY.]

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NOTICE TO THE PUBLIC.—Office of the Electric Gas Lighting Company, 45 Milk Street, Boston, Mass., October 25, 1883. Notice is hereby given that the contract heretofore existing between this Company and the Electrical Supply Company of Ansonia, Conn, whereby the latter was licensed to manufacture and sell electric gas-lighting apparatus, under the patents owned by the former, was cancelled by this Company on the 20th day of September, 1883, for non-fulfillment and violation of its terms, conditions and covenants, on the part of said Electrical Supply Company. Any manufacture or sale of said apparatus by said Electrical Supply Company, since the cancellation of said contract, is an infringement of the patents, and in violation of the rights of this Company, and all parties who shall sell, purchase, or use said apparatus, thus manufactured, will be held responsible. We have perfected arrangements for the prompt construction of the apparatus by manufacturing electricians, who have had extended practical experience in this line of work, thus ensuring the production of properly made and perfect working burners, which we shall supply to our agents and patrons in full confidence that they will give entire satisfaction. We regret the interruption and delay which has been occasioned by the action of the Electrical Supply Company; but its failure to furnish the apparatus according to contract, and the small amount which it did furnish, while said contract was in force, was so defective in construction and inferior in quality, that it became our imperative duty to ourselves and our patrons to exercise our right to terminate the contract for breach of its conditions.

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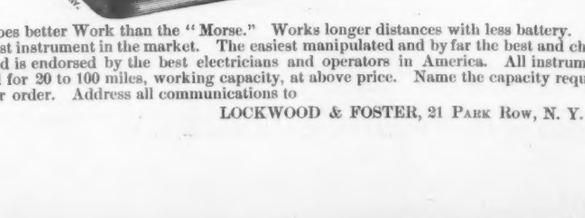

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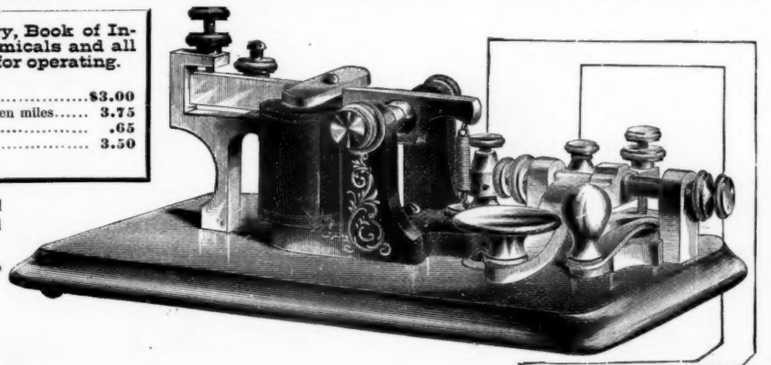

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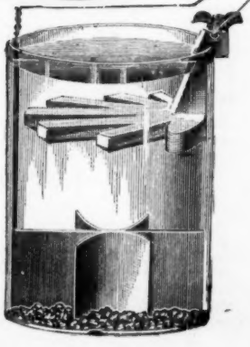

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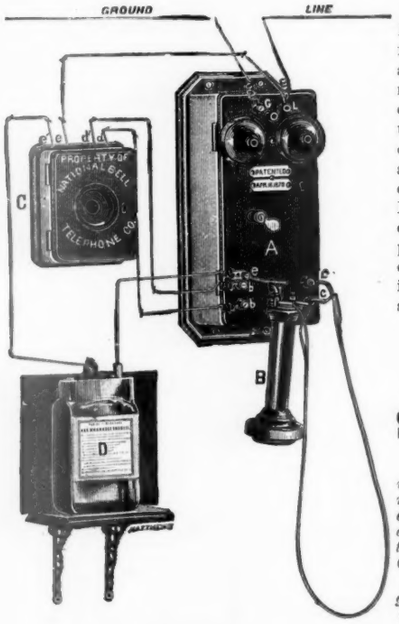

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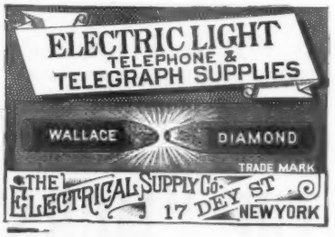

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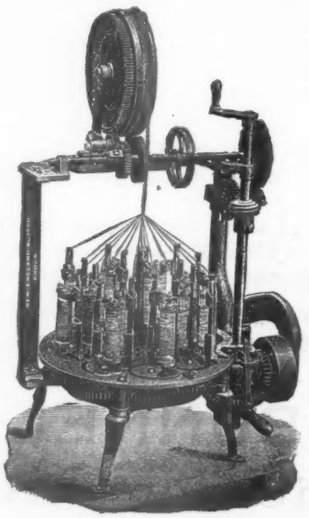

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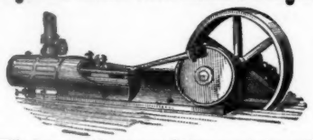

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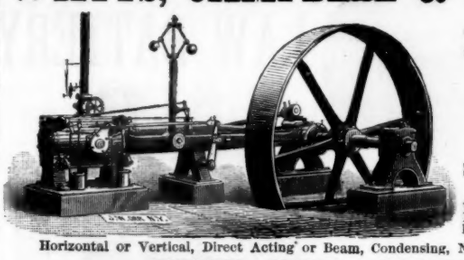

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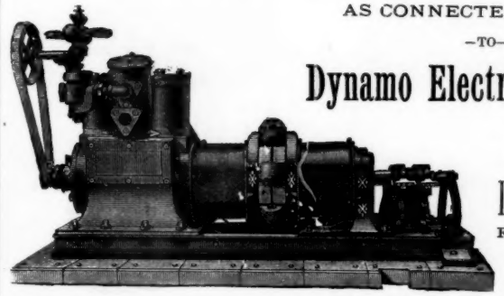

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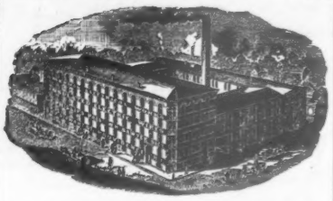

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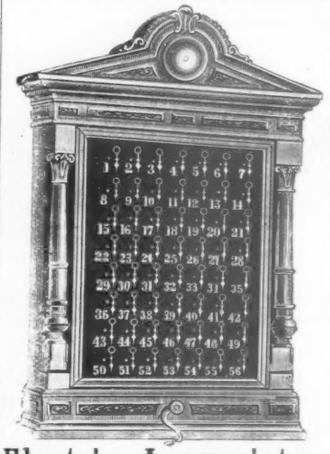

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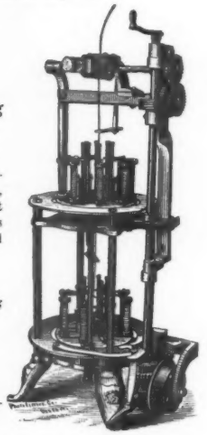

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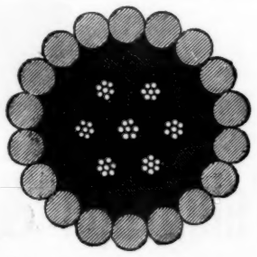

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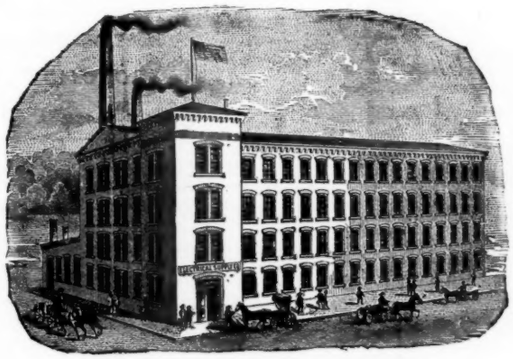

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